



**JAPANESE JOURNAL OF BOTANY**

Volume IX

**Publication Committee**

S. IKENO (*Chief Editor*)

K. KÔRIBA

K. SHIBATA

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NATIONAL RESEARCH COUNCIL OF JAPAN

學術研究會議編纂

日本植物學輯報

原著及抄錄

昭和十四年 第九卷

JAPANESE  
JOURNAL OF BOTANY

Transactions and Abstracts

Volume IX  
(1937-39)

TOKYO  
1939



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## DATE OF PUBLICATION

Transactions 1-120, September 30, 1937; 121-257, March 31, 1938;  
259-351, October 30, 1938; 353-394, March 31, 1939.

Abstracts (1)-(32), September 30, 1937; (33)-(98), March 31, 1938;  
(99)-(143), October 30, 1938; (145)-(183), March 31, 1939.

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# Karyological studies in *Crocus* I

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With 96 text-figures

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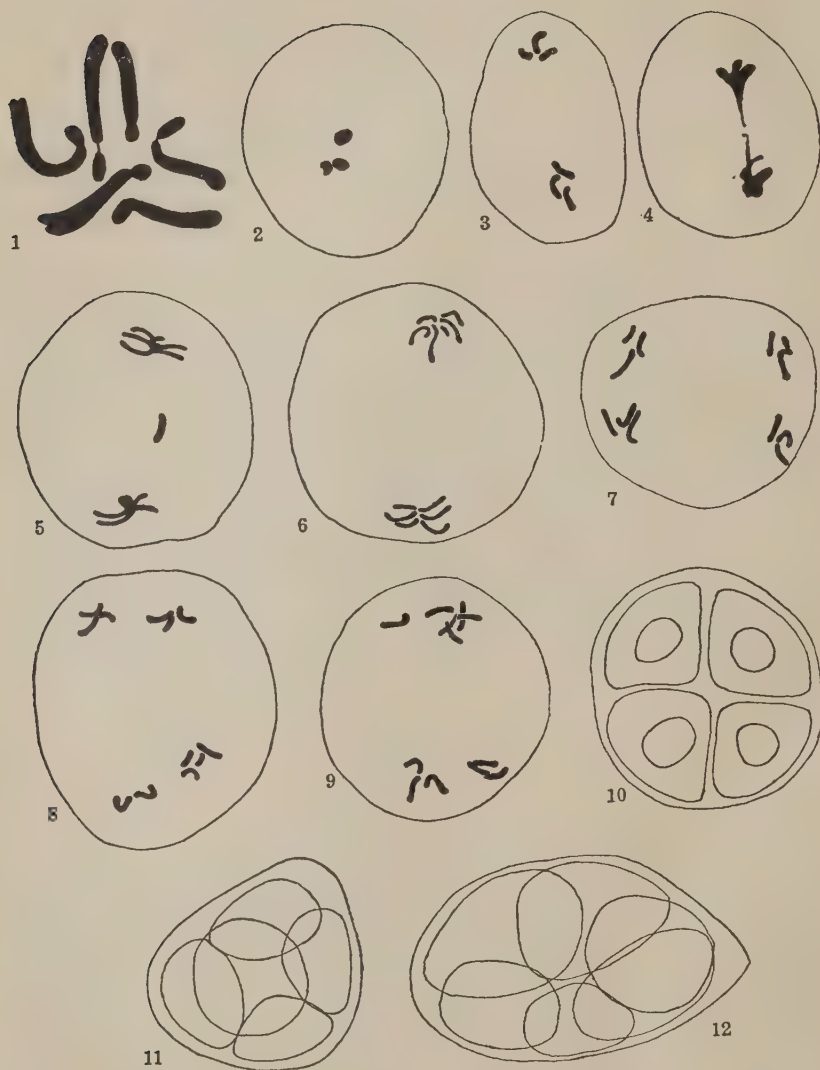
(Received March 19, 1937)

The genus *Crocus* has furnished excellent material for cytological study because of its abundant chromosome variations. The popular and widely cultivated *Crocus*, including several Linnean species and a number of garden forms mostly belonging to *C. vernus*, have already been the subjects of study (KARASAWA, 1932, 1933, 1935 and others). However, other uncommon *Crocus* that are rarely cultivated in our gardens, have not yet been investigated, although their somatic chromosomes have mostly been studied by MATHER (1932). The object of this paper is to describe the karyological observations of these *Crocus* in connection with their abnormal chromosome behavior. The materials used in this study were obtained directly from BARR & SONS and C. G. VAN TUBERGEN. The expenses of the present investigation were partly defrayed by a grant from the Imperial Academy, to the council of which I wish to record here my grateful thanks.

## Observations

### 1. *Crocus Olivieri*

According to MATHER (1932), this species contains six somatic chromosomes in its root tip cells, the same number as I have observed, as shown in Fig. 1. Of these six chromosomes, one pair of chromosomes has a large satellite, while the remaining two exhibit short arms, which however differ distinctly in size. At the metaphase of the first divisions in the PMC, three bivalents were counted (Fig. 2). As a rule, the reduction divisions proceeded normally (Figs. 3-4 and 6-7), although lagging chromosomes were observed in a few cases (Fig. 5). Sometimes, unequal distributions of the chromosomes occurred in the second division (Figs. 8-9). The majority of the PMC produce normal pollen-tetrads (Fig. 10), while some of them gave rise to polyspory (Figs. 11-12) owing to irregular chromosome behavior. The frequency of the number of young daughter cells in the PMC is shown in table 1.



Figs. 1-12. *Crocus Olivieri*. 1, Somatic nuclear plate, showing 6 chromosomes.  $\times 2400$ . 2-5, First division. 6-10, Second division.  $\times 1200$ . 11, Pollen-pentad. 12, Pollen-hexad.  $\times 800$ .



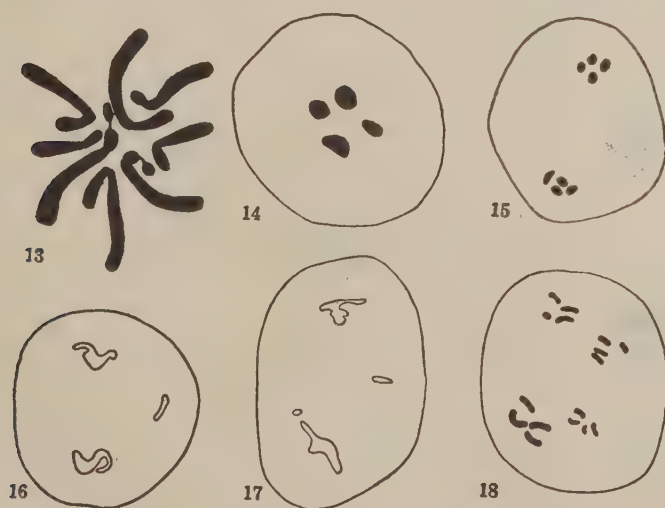
TABLE 1

Number of young daughter cells in the PMC	4	5	6	Total
Frequency	94	5	1	100

The mature pollen appeared to be normal, although a few of them were deformed.

## 2. *Crocus aureus*

The diploid chromosome number of this species is 8 (Fig. 13), as observed by MATHER (1932). A pair of somatic chromosomes contained distinct satellites on the proximal short arms, as seen in Fig. 13. At the



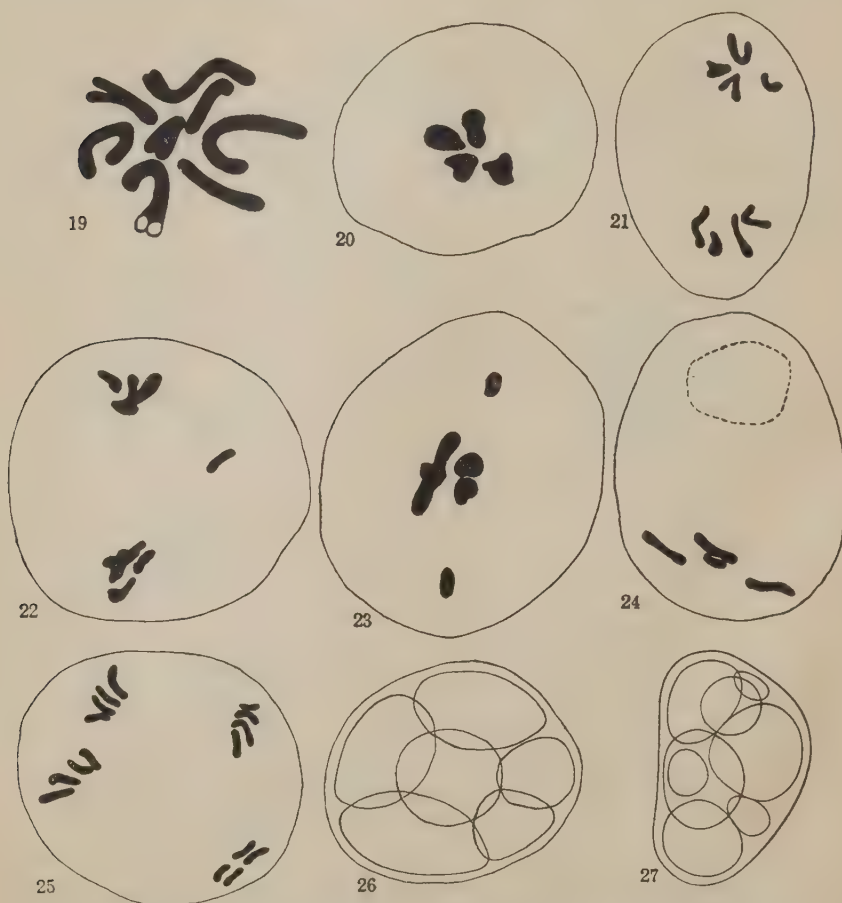
Figs. 13-18. *Crocus aureus*. 13, Somatic nuclear plate, showing 8 chromosomes.  $\times 2400$ . 14-17, First division. 18, Second division.  $\times 1200$ .

first metaphase in the PMC, four bivalents were counted (Fig. 14). As a rule, the meiosis was accomplished normally (Figs. 15, 18), although in some cases the chromosomes behaved irregularly (Figs. 16-17). Table 2 shows the frequency of the number of young microspores in the PMC.

TABLE 2

Number of young microspores in the PMC	4	5	6	7	8	9	Total
Frequency	69	13	10	5	2	1	100

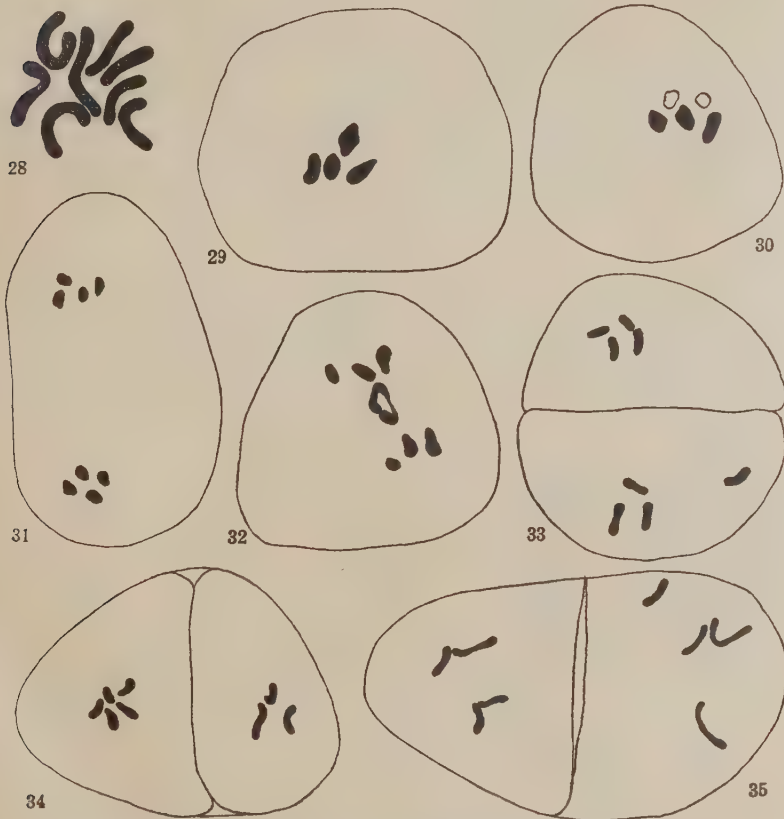
The pollen grains were mostly uniform in size and shape, although some of them were shrunken.



Figs. 19-27. *Crocus biflorus*. 19, Somatic equatorial plate, showing 8 chromosomes.  $\times 2400$ . 20-23, First division. 24-25, Second division.  $\times 1200$ . 26-27, Supernumerary young pollen grains in the PMC.  $\times 800$ .

3. *Crocus biflorus*

As counted by MATHER (1932), this herb showed eight chromosomes in its somatic cells (Fig. 19). Four bivalents, half the number of the diploid, were observed in the PMC (Fig. 20). Usually the meiotic figures were normal (Fig. 21), although in a few cases some of the chromo-



Figs. 28-35. *Crocus chrysanthus* Moonlight. 28, Somatic equatorial plate, showing 8 chromosomes.  $\times 2400$ . 29-32, First division. 33-35, Second division.  $\times 1200$ .

somes either lagged, or passed to the poles ahead of the others (Figs. 22-23). The second division took place normally (Fig. 25), although in some figures the chromosomes were distributed at random without undergoing longitudinal splitting (Fig. 24). As the result of these failures, the PMC

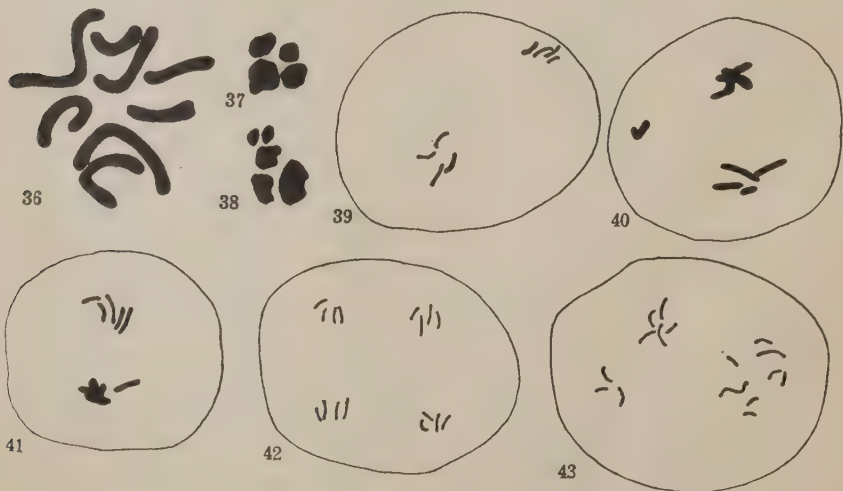
with many daughter cells were frequently observed (Figs. 26–27). Most of the mature pollen grains looked normal, although those of smaller size were occasionally observed.

#### 4. *Crocus chrysanthus* Moonlight

Eight somatic chromosomes were observed in the root tip cells of this species (Fig. 28). At the metaphase of the first division, four bivalents were usually counted (Fig. 29), although in some figures either univalent chromosomes, or chromosome-ring appeared (Figs. 30, 32). The meiosis proceeded normally in most PMC (Fig. 31). In some figures, however, the chromosomes either were disjoined unequally, or had lagged, or were scattered in the cytoplasm (Figs. 33–35). Although most of the pollen grains were normal in appearance, some of them were deformed.

#### 5. *Crocus etruscus*

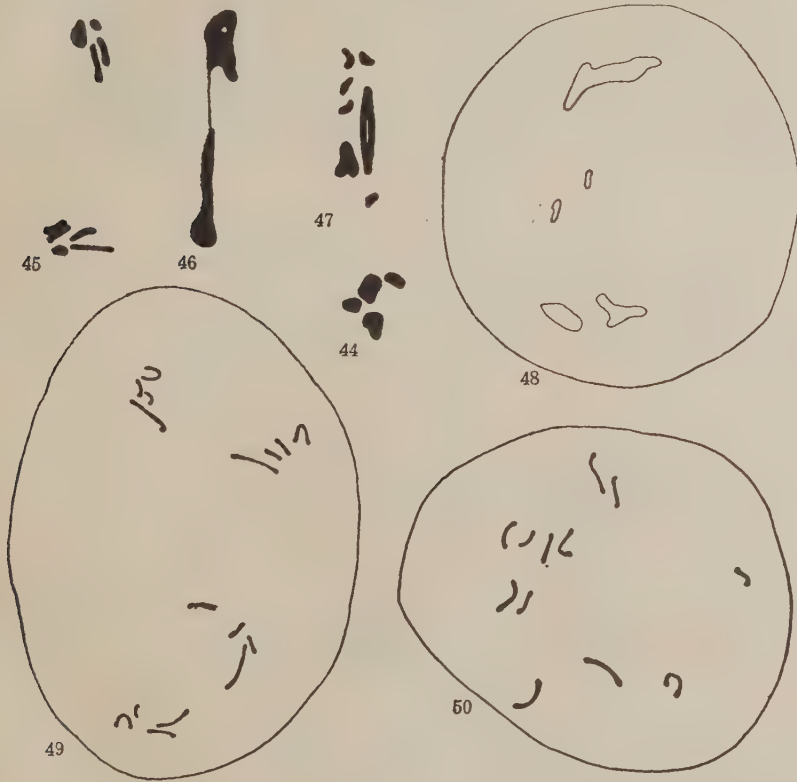
Although according to MATHER (1932), this herb contains eleven chromosomes in its somatic cells, I found that it has eight somatic chromosomes in its root tip cells (Fig. 36)—a difference that may be due to differences in the materials used. Of these eight chromosomes, one pair



Figs. 36–43. *Crocus etruscus*. 36, Somatic chromosomes ( $2n = 8$ ).  $\times 2400$ . 37, Four bivalents at the first metaphase. 38, Five chromosomes consisting of three bivalents and two univalents.  $\times 1200$ . 39–41, First division. 42–43, Second division.  $\times 800$ .



of chromosomes was fairly long, the other pair medium, and the remaining two pairs short. At the metaphase of the first division, four bivalents were observed in about 60 per cent of the figures (Fig. 37), five chromosomes consisting of three bivalents and two univalents in about 35 per cent (Fig. 38), and six chromosomes involving four univalents in about



Figs. 44-50. *Crocus zonatus*. 44, Four bivalents at the first metaphase. 45-48, First division. 49-50, Second division.  $\times 1200$ .

5 per cent. The reduction divisions were accomplished normally in about half of PMC (Figs. 39, 42). In the remaining figures, however, the chromosomes either lagged, or separated unequally (Figs. 40-41 and 43). Owing to these abnormal chromosome behavior, the mature pollen varied greatly in size and shape.

### 6. *Crocus zonatus*

Since there were eight somatic chromosomes in its root tip cells (MATHER, 1932; BRITTINGHAM, 1934; KARASAWA, 1935), four bivalents were counted (Fig. 44). As a rule, the figures of the PMC divided normally (Figs. 45, 49), although sometimes either chromosome bridges (Fig. 46) or unequally separated chromosomes (Fig. 47) or laggards (Fig. 48) were observed. In a few cases, the divisions were so irregular that the chromosomes were scattered about in the cytoplasm (Fig. 50). The mature pollen were mostly uniform in size and shape, although some of them were deformed. Although the behavior of the chromosomes was abnormal to some extent, fertility was normal and the seeds germinated normally.

### 7. *Crocus ochroleucus*

The somatic chromosome number of this species was found to be ten (Fig. 51), as observed by MATHER (1932). At the first metaphase, five bivalents (half of the diploid) occurred (Fig. 52). At their heterotypic divisions, the chromosomes, in most cases, were distributed equally



Figs. 51-56. *Crocus ochroleucus*. 51, Somatic chromosomes ( $2n=10$ ).  $\times 2400$ . 52-56, First division.  $\times 1200$ .

to the different poles (Fig. 53), although sometimes they either were separated unequally (Fig. 54), or had lagged (Fig. 55), or were scattered (Fig. 56). Most of the resulting pollen appeared to be normal. Fertility was as high as normal.

8. *Crocus pulchellus*

As counted by HEITZ (1926) and MATHER (1932), twelve somatic chromosomes were detected in the root tip cells of this species (Fig. 57). Six bivalents were usually observed (Fig. 58), although in some cases univalent chromosomes appeared (Fig. 59). The reduction division took



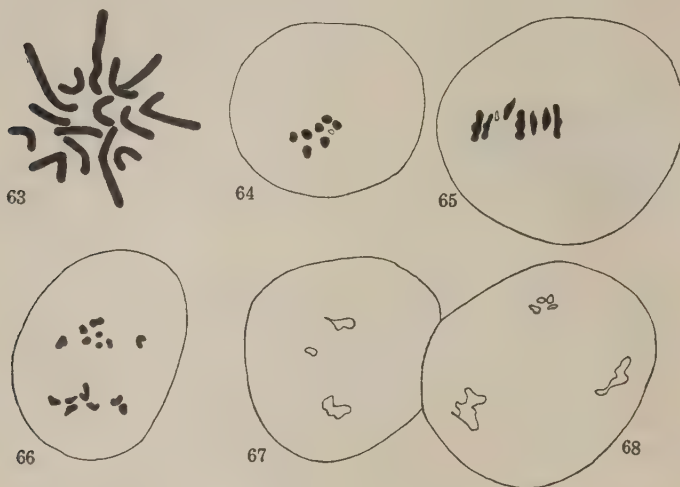
Figs. 57-62. *Crocus pulchellus*. 57, Somatic nuclear plate, showing 12 chromosomes.  $\times 2400$ . 58, Six bivalents at the first metaphase. 59, Seven chromosomes consisting of five bivalents and two univalents (shown in outline). 60-62, First division.  $\times 1200$ .

place normally in most PMC (Fig. 60). Sometimes, however, lagging chromosomes were observed (Figs. 61-62). The mature pollen were mostly normal in appearance, although some of them were deformed. Fertility was normal, the seeds germinating normally.

9. *Crocus sativus* var. *Elwesii*

According to MATHER (1932), this variety contains fifteen somatic chromosomes in its root tip cells, the same number that I have observed (Fig. 63). At the first metaphase, seven bivalents and one univalent were usually observed (Figs. 64-65). In the first division, the chromosomes were mostly distributed to 7 and 8 (Fig. 66), although in some figures the chromosomes either had lagged, or had formed chromatin granules (Figs. 67-68). As the result of these abnormal divisions, the mature pollen were very irregular in shape and size, some of them being shrunken. In its external characters, this variety greatly resembles Saffron (*Crocus sativus*), except that the former has more slender leaves

and more delicate flowers. From the fact that Saffron is autotriploid ( $n = 8$ ) (cf. KARASAWA, 1933), and in view of what has just been mentioned, the chromosome formula of this variety may be given as  $2n-1$ .

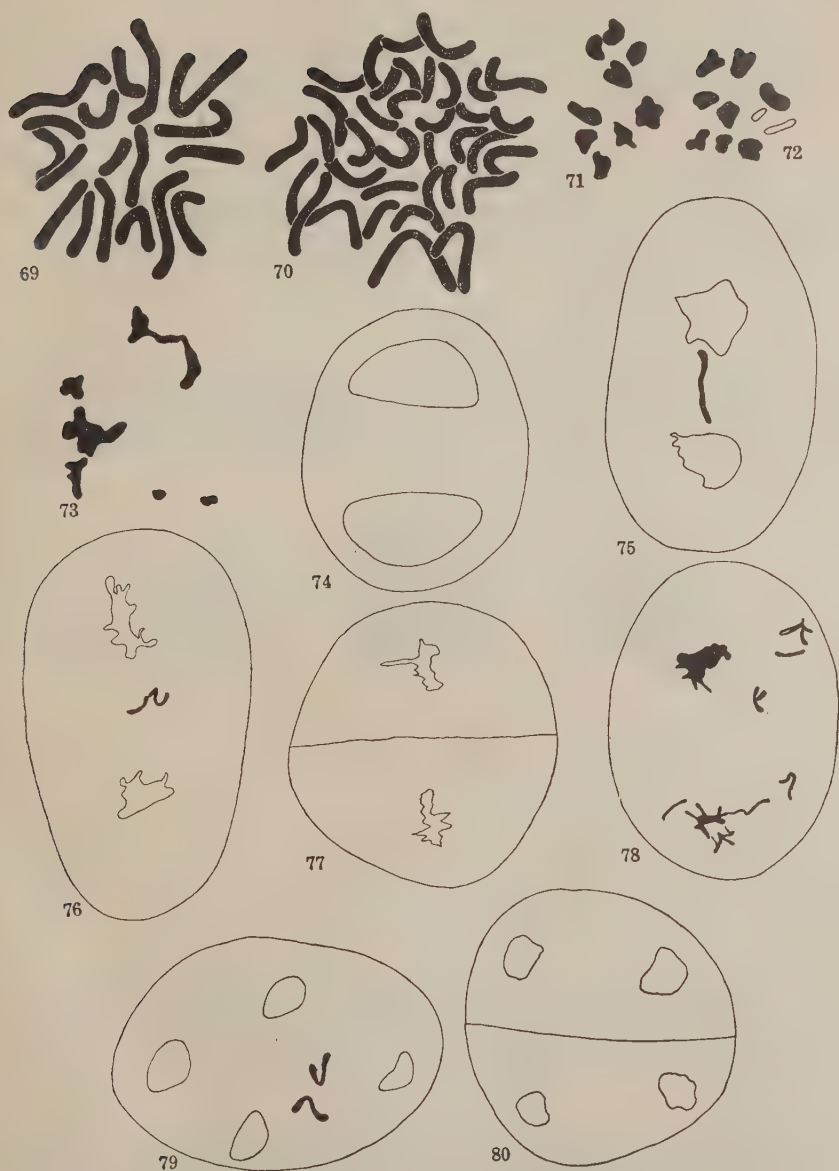


Figs. 63-68. *Crocus sativus* var. *Elwesii*. 63, Somatic equatorial plate, showing 15 chromosomes.  $\times 2400$ . 64, Polar view of seven bivalents and one univalent (shown in outline). 65, Side view of the same. 66, Unequal distribution of the chromosomes in the first division. 67-68, Lagging chromosomes between two poles.  $\times 1200$ .

## 10. *Crocus speciosus*

As found by MATHER (1932), this ornamental herb has eighteen somatic chromosomes in its root tip cells (Fig. 69), tetraploid cells being also frequently observed in the same root tip (Fig. 70). At the first metaphase, nine bivalents were usually counted (Fig. 71), although sometimes either univalent chromosomes, or irregular conjugations of the chromosomes were observed (Figs. 72-73). The meiosis seemed to proceed normally in most cases, resulting in normal pollen-tetrads (Figs. 74, 77 and 80). Sometimes, however, lagging chromosomes were observed both in heterotypic as well as homotypic divisions (Figs. 75-76 and 79). In a few cases, the chromosomes were distributed very irregularly, as seen in Fig. 78. The frequency of the number of young pollen in the PMC is shown in table 3.





Figs. 69-80. *Crocus speciosus*. 69, Somatic chromosomes ( $2n = 18$ ). 70,  $36 (4n)$  somatic chromosomes in the same root tip cells.  $\times 2400$ . 71, Nine bivalents in the first metaphase. 72, Eight bivalents and two univalents (shown in outline) in the heterotypic metaphase. 73, Irregular conjugation of chromosomes.  $\times 1200$ . 74-76, First division. 77-80, Second division.  $\times 800$ .

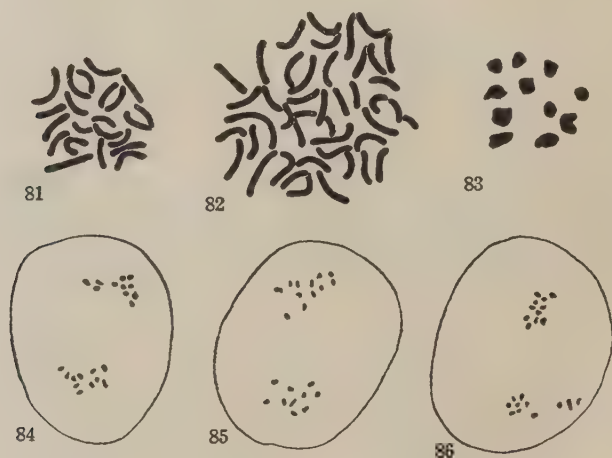
TABLE 3

Number of young pollen in the PMC	4	5	6	7	Total
Frequency	64	4	1	1	70

Although the pollen were somewhat deformed, fertility was normal and a number of seedlings were obtained.

### 11. *Crocus Sieberi*

The diploid chromosome number of this species was found to be 22 (Fig. 81), agreeing with MATHER's result (1932). Tetraploid cells were frequently observed in the same root tip (Fig. 82). Eleven bivalents were counted in the first metaphase (Fig. 83). Usually the reduction divi-



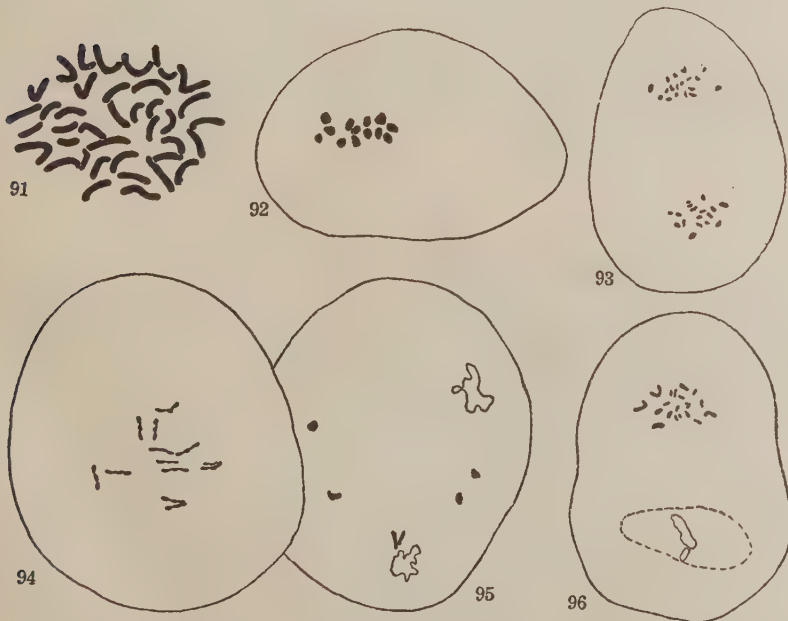
Figs. 81-86. *Crocus Sieberi*. 81, Somatic chromosomes ( $2n = 22$ ). 82, 44 ( $4n$ ) somatic chromosomes in the same root tip cells.  $\times 2400$ . 83, 11 bivalents at the first metaphase.  $\times 1800$ . 84, Normal first division. 85, Non-disjunction, showing 10 chromosomes in the lower pole and 12 chromosomes in the upper pole. 86, Three laggards between two poles.  $\times 800$ .

sions took place normally (Fig. 84). Sometimes, however, the chromosomes either were disjoined unequally, distributing themselves to 10 and 12 (Fig. 85); or had lagged (Fig. 86). On account of these abnormal divisions, the resulting pollen were fairly deformed, although a few giant pollen grains which are twice as large as the normal were observed. Judg-

ing from the external characters as well as from the chromosome behavior, a *Crocus* that is being sold by our Yamato Shubyô under the name *Kanzaki Crocus* may be identified with *C. Sieberi*. This *Crocus*, however, showed low irregularity in its meiosis.



Figs. 87-90. *Crocus Imperati*. 87, Somatic nuclear plate, showing 26 chromosomes. 88, 13 bivalents at the first metaphase.  $\times 2400$ . 89-90, Chromatin granules.  $\times 800$ .



Figs. 91-96. *Crocus versicolor picturatus*. 91, Somatic equatorial plate, showing 39 chromosomes. 92, Polar view of 13 trivalents in the first metaphase.  $\times 2400$ . 93, Abnormal distribution of chromosomes in the PMC. 94, Side view of 13 trivalents in the first metaphase. 95-96, Abnormal heterotypic divisions.  $\times 1200$ .

## 12. *Crocus Imperati*

Twenty-six somatic chromosomes were observed in the root tip cells of this herb (Fig. 87), as reported by MATHER (1932) and BRITTINGHAM (1934). At the first metaphase, thirteen bivalents were counted (Fig. 88). The reduction division seemed to have been accomplished normally. Sometimes, however, abnormal figures with chromatin granules in the cytoplasm were observed (Figs. 89-90). The pollen grains mostly appeared normal with high fertility. The seeds germinated normally.

## 13. *Crocus versicolor picturatus*

MATHER (1932) and BRITTINGHAM (1934) counted twenty-six somatic chromosomes in the root tip cells of this species. My material, which came from BARR & SONS, however, proved to be triploid, showing thirty-nine somatic chromosomes (Fig. 91). At the metaphase of the heterotypic division, thirteen trivalent chromosomes were usually counted (Figs. 92, 94), although the chromosomes frequently failed to conjugate, resulting in some bivalents and univalents. Owing to triploidy, the reductions were irregular (Figs. 93, 96), the chromosomes frequently lagging in the cytoplasm (Fig. 95). The result of these abnormal divisions is seen in the markedly deformed pollen.

## Summary

1. Karyological observations chiefly in connection with meiotic chromosomes were made in twelve species and one variety of *Crocus*.

2. The somatic chromosome numbers of these *Crocus* mostly agreed with the results of previous investigators (HEITZ, 1926; MATHER, 1932; BRITTINGHAM, 1934), although my counts in *C. etruscus* and *C. versicolor picturatus* showed 8 and 39 somatic chromosomes respectively.

3. The haploid chromosome numbers were determined to be 3 in *C. Olivieri*, 4 in each of *C. aureus*, *C. biflorus*, *C. chrysanthus* Moonlight, *C. etruscus*, *C. zonatus*, 5 in *C. ochroleucus*, 6 in *C. pulchellus*, 9 in *C. speciosus*, 11 in *C. Sieberi*, and 13 in *C. Imperati*, while the basic chromosome number of *C. versicolor picturatus* was 13. The chromosome formula of *C. sativus* var. *Elwesii*, however, may be given as  $2n-1$  ( $n = 8$ ).

4. Abnormal chromosome behavior such as non-disjunction, lagging, etc., were observed to a greater or less extent in the course of sporogenesis of all these species of *Crocus*.

5. Tetraploid cells were frequently observed in the root tip of *C. speciosus* and *C. Sieberi*.



6. The fertility of *C. zonatus*, *C. ochroleucus*, *C. pulchellus*, *C. speciosus* and *C. Imperati* was normal, although the mature pollen of these *Crocus* were more or less deformed.

7. As a rule the seeds of *C. zonatus*, *C. pulchellus*, *C. speciosus* and *C. Imperati* germinated normally.

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# Studies in the cytology of Pteridophyta XIV. Spermatoteleosis<sup>(1)</sup> and fertilization in some ferns, with special reference to border-brim

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With plate I and 58 text-figures

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(Received March 26, 1937)

That the motor-apparatus of the spermatozoid of ferns was composed of border-brim, lateral bar and cilia-bearing band upon which cilia grow and that these three portions should be called the blepharoplast has already been advocated by the writer (1932, 1933, 1934). He also studied the development of the border-brim, the cilia-bearing band and the lateral bar in the spermatoteleosis of *Notogramme japonica* and *Pteris multifida* (1934) and made a preliminary report on the behaviour of the border-brim in the fertilization of *Adiantum capillus-veneris* and *Pteris cretica* var. *albo-lineata* (1936d).

In the present work the writer investigated the development and behaviour of the blepharoplast in the spermatoteleosis and fertilization of some other ferns and confirmed the previous results.

Though the plastids and chondriosomes in the spermatid and egg-cell of ferns have already been studied by EMBERGER (1922) a further observation was carried out by the writer in the present case.

The origin of the blepharoplast has been often discussed by various authors. In the study of *Stemonitis* the writer confirmed the fact that in mitotic division of the cyst-stage planocyte the centrosome directly becomes the blepharoplast, the origin of which was in the nucleus. In the present work the origin of the blepharoplast was also pursued in some ferns and found it to be of nuclear.

## Materials and methods

The prothallia of *Adiantum capillus-veneris* L. (Japanese name: *Hôraisida*), *Athyrium nipponicum* HANCE (Japanese name: *Inuwarabi*), *Ceratopteris thalictroides* BRONGN. (Japanese name: *Mizuwarabi*), *Cyathea*

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(1) See YUASA, A. 1934, p. 389, foot-note.

*boninsimensis* COPEL. (Japanese name: *Hego*), *Lemmaphyllum microphyllum* PRESL. (Japanese name: *Mamezuta*), *Dryopteris crassirhizoma* NAKAI (Japanese name: *Osida*), *Dryopteris oligophlebia* C. CHR. var. *elegans* H. ITÔ (Japanese name: *Himewarabi*), *Leptogramme totta* J. SM. (Japanese name: *Mizosida*), *Lygodium japonicum* SW. (Japanese name: *Turustinobu*), *Dryopteris varia* O. KUNTZE (Japanese name: *Itatisida*), *Phlebodium aureum* L. (Japanese name: *Taiwan-arabosi*), *Pteris cretica* L. var. *albo-lineata* HK. (Japanese name: *Hagoromosida*), and *Pteris multifida* POILET (Japanese name: *Inomotosô*) were used as the materials for the present study.

For the study of spermatogenesis and fertilization the prothallia were fixed with chrom-acetic acid solution, chrom-acetic acid solution + distilled water (1:1) or FLEMMING's solution (Bonn), sectioned by the paraffin-method to a thickness of 5–8  $\mu$  and stained with HEIDENHAIN's iron-alum haematoxylin with or without being counter-stained with a 1% alcoholic solution of light green. For the study of chondriosomes and plastids the prothallia were fixed with BENDA's solution, CHAMPY's solution or REGAUD's solution and stained with HEIDENHAIN's iron-alum haematoxylin. Sometimes chondriosomes were stained *in vivo* with 1% aqueous solution of Janus green. Plastids were also stained *in vivo* with potassium iodide iodine solution.

To study the nuclear structure the material was refixed and stained with aceto-carmin after fixation with CARNOY's fluid (3:1).

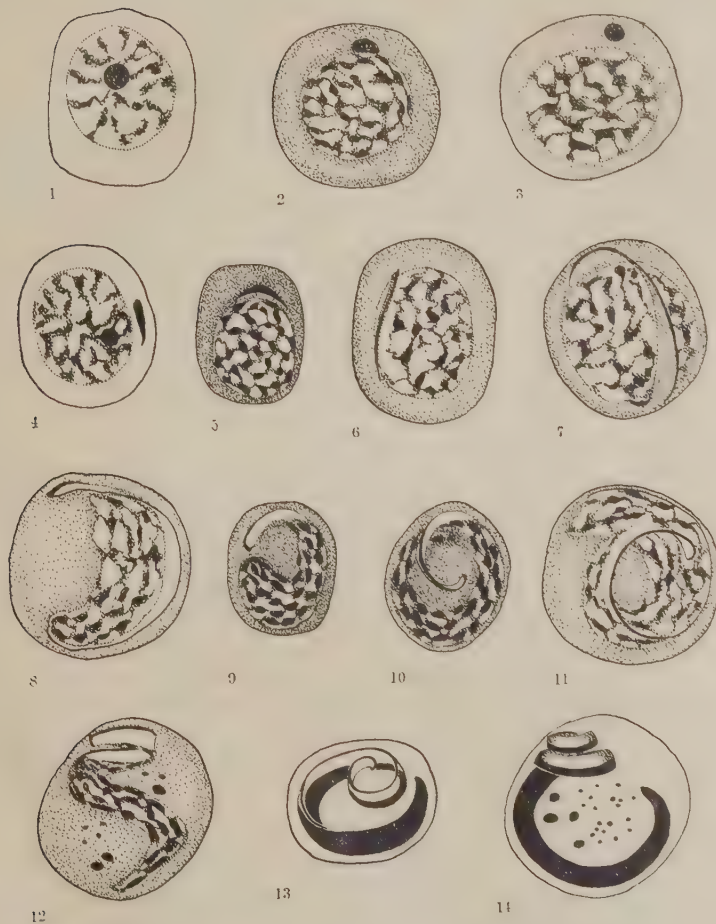
The materials were observed vitally under the microscope for purposes of comparison with those in the fixed and stained state.

### Spermatoteleosis and border-brim

As stated in the case of *Notogramme japonica* and *Pteris multifida* (1934) the blepharoplast appears, at first, as a little spherical body in the spermatid-cytoplasm in every case of fern studied (the origin of the blepharoplast will be discussed later on) (Photo 7, Figs. 2, 3, 31, 56, 57, 58). The spherical blepharoplast becomes a wedge-shaped band, elongates along the surface of the nucleus of the spermatid (Photo 9, Figs. 4, 5, 6, 32, 33) and makes a half circle (Photo 8, Figs. 7, 8, 34). At the time when the blepharoplast becomes a wedge-shaped band the one edge of the latter which is somewhat thick stains deeply and the remaining portion stains faintly or not at all (Figs. 6, 7, 8, 9, 32, 33). The deeply stained edge is thought to develop into the border-brim and lateral bar when the spermatozoid is completed.

The nucleus metaphorphoses into a crescent-shaped body (Photo 8, Figs. 8, 9, 17, 40, 41). The half-circular blepharoplast comes into con-





Figs. 1-14. Spermatotelysis in some ferns, fixed with chrom-acetic acid solution.  $\times$ ca. 3000. Fig. 1. Spermatogenous cell. Figs. 2, 3. Blepharoplast appears in the spermatid. Figs. 4-7. Blepharoplast elongates along the surface of the nucleus. Figs. 8, 9. Nucleus becomes crescent-shaped. Border-brim and cilia-bearing band differentiate from the blepharoplast. Figs. 10, 11. Blepharoplast coalesces with the nucleus. Fig. 12. Almost completed spermatozoid. Figs. 13, 14. Mature spermatozoid within the spermatid-membrane. Cilia are not shown.

Figs. 1, 4, *Dryopteris crassirhizoma* NAKAI; Figs. 2, 3, 6, 7, 8, 11, 12, 14, *Dryopteris oligophlebia* C. CHR. var. *elegans* H. ITÔ; Figs. 5, 9, 10, 13, *Cyathea boninsimensis* COPEL.

tact along its whole length with the surface of the convex-side of the crescent-shaped nucleus (Figs. 8, 9).

Owing to the elongation of the blepharoplast some of the cytoplasm around the blepharoplast is pushed into the opposite side of the nucleus and presses the latter to the side of the blepharoplast, so that the nucleus is transformed into a crescent-shaped body and comes in contact with the blepharoplast.

The blepharoplast coalesces along the whole of its length with the nucleus, making a projection beyond the anterior portion of the latter (Fig. 9). The anterior end of the nucleus, however, elongates beneath the blepharoplast and becomes gradually narrower (Fig. 10). Between the border-brim and the anterior tapering portion of the nucleus there remains the unstained or faintly stained portion of the blepharoplast: this is the earlier stage of the cilia-bearing band and is wedge-shaped (Figs. 9, 10, 11). The anterior edge of the cilia-bearing band also stains deeply and is called the lateral bar (Fig. 12).

The border-brim of the spermatozoid of *Lygodium japonicum*, *Dryopteris oligophlebia* var. *elegans*, *Cyathea boninsimensis* or *Dryopteris crassirhizoma* occupies half the length of the spermatozoid-body. During the spermatoteleosis of these ferns the posterior end of the nucleus continues to elongate after the nucleus becomes crescent-shaped, while that of the border-brim remains as it was until the completion of the spermatozoid (Fig. 10, 11, 35). However, in the case of *Pteris cretica* var. *albo-lineata*, *Pteris multifida* or *Athyrium nipponicum* in which the border-brim runs often or always along the whole length of the nucleus (Figs. 43, 44) the posterior end of the blepharoplast continues to elongate together with the nucleus after the coalescence with the crescent-shaped nucleus till the completion of the spermatozoid.

When the cilia-bearing band is completed the cilia appear as projections upon the surface of the cilia-bearing band and elongate gradually.

In the completed spermatozoid five portions can be distinguished: namely, border-brim, cilia, cilia-bearing band, lateral bar and nucleus (Figs. 13, 14).

The membrane of the spermatid-nucleus is not destroyed during spermatoteleosis and is thought to become the nuclear membrane of the spermatozoid.

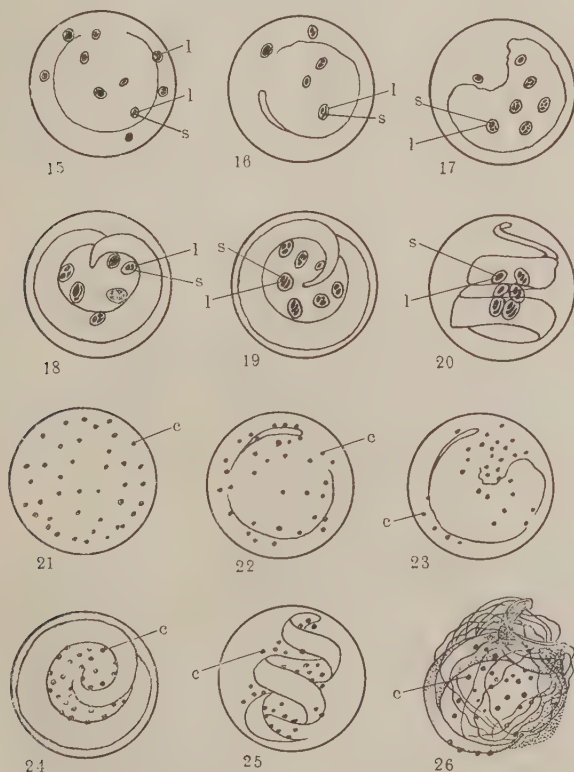
In the nucleus of the spermatid no nucleolus is seen (Figs. 29, 30, 56, 57, 58), but in the case of *Dryopteris crassirhizoma* a karyosome is seen in the nucleus of the spermatid (Fig. 1).

As already stated (1934) the blepharoplast appears as a little spherical body in the spermatid and furnishes a spermatozoid with border-brim, cilia, cilia-bearing band and lateral bar. So that the border-

brim, cilia-bearing band and lateral bar as a whole should be designated as the blepharoplast of the spermatozoid.

### Plastids and chondriosomes during spermatoteleosis

Starch grains are not at first seen in the spermatid. When the spermatid begins to be transformed into a spermatozoid small starch grains appear in the cytoplasm of the spermatid. They are enveloped in thin unstained hulls which are thought to be leucoplasts (Fig. 15). At first



Figs. 15-20. Spermatoteleosis in *Adiantum capillus-veneris* L., showing the change and behaviour of starch grains and plastids, stained with potassium iodide iodine solution; somewhat schematically drawn. *l*, leucoplast; *s*, starch grain.  $\times$ ca. 2000. Figs. 21-26. Spermatoteleosis in *Athyrium nipponicum* HANCE, showing the behaviour of chondriosomes, stained with 1% aqueous solution of Janus green; somewhat schematically drawn. *c*, chondriosome.  $\times$ ca. 2000.

the starch grain appears singly in a leucoplast which is then small. In the course of spermatoteleosis the leucoplast increases in both number and size, and often contains two or more small starch grains. Perhaps the spermatid in the early stages contains small plastid primordia which are at the leucoplast stage and are discerned only with difficulty with potassium iodide iodine solution. As the processes of spermatoteleosis progress these small plastid primordia (leucoplasts) increase in both their number and size and begin to accumulate starch grain inside them (Figs. 15, 16, 17). As the spermatozoid approaches its completion the leucoplasts are gradually gathered into the central portion of the spermatid, being thus sucked in by the spiral of the spermatozoid-body (Figs. 18, 19, 20).

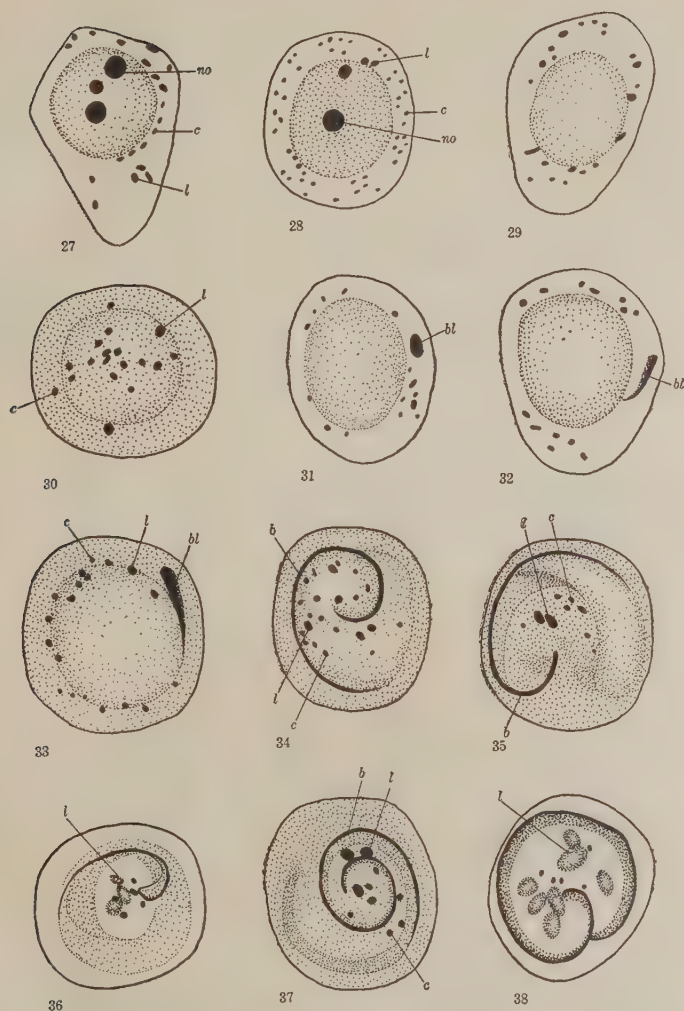
When the spermatozoid is extruded out of the spermatid-membrane the cytoplasm of the spermatid which contains leucoplasts coheres around the spermatozoid-body. The starch grains within the leucoplast are thrown away together with the spermatid-cytoplasm while the spermatozoid swims rapidly. In some cases, however, the plastids are arranged on the surface of the spermatozoid-body at the moment of the extrusion of the spermatozoid from the spermatid-membrane.

When staining is carried out with 1% aqueous solution of Janus green many small granules (chondriosomes) which stain faint violet can be seen in the cytoplasm of the spermatid (Fig. 21). The number of the chondriosomes is almost constant throughout the course of spermatoteleosis (Figs. 22-26). When the spermatozoid is extruded out of the spermatid-membrane the cytoplasm of the spermatid coheres around the spermatozoid-body. The chondriosomes are seen in this residue of the spermatid-cytoplasm and are thrown away together with the latter during the rapid movement of the spermatozoid.

An observation was also made on the material which has been fixed and stained according to the chondriosome-technique. Many granular chondriosomes are scattered in the cytoplasm of the spermatid and these are sucked in by the spiral of the spermatozoid-body in the course of spermatoteleosis (Figs. 29-38). This behaviour of the chondriosomes has been already observed by EMBERGER (1922) in the spermatid of *Adiantum capillus-veneris*. As already stated the cytoplasm of the spermatid attaches itself around the spermatozoid-body even after the latter has been extruded out of the spermatid-membrane and contains chondriosomes. The residue of the cytoplasm is, however, thrown away during the active swimming of the spermatozoid.

*As the metamorphosis of the spermatid into a spermatozoid progresses it seems that a great quantity of carbohydrates is produced in the spermatid-cytoplasm and that these carbohydrates are reserved as starch grains in the plastid primordia. Accordingly the plastid primordia*





Figs. 27-38. Spermatotelysis in ferns, fixed with BENDA's solution (Figs. 27, 29, 31, 32) or CHAMPY's solution (Figs. 28, 30, 33, 34, 35, 36, 37, 38).  $\times$  ca. 2000. Figs. 27, 28. Spermatogenous cell. Figs. 29, 30. Spermatid. Fig. 31. Blepharoplast appears. Figs. 32, 33. Blepharoplast elongates. Fig. 34. Nucleus becomes crescent-shaped. Figs. 35, 36. Nucleus metamorphoses into a spiral-shaped body, coalescing with the blepharoplast. Figs. 37, 38. Completed spermatozoid. Cilia are not shown. *b*, border-brim; *bl*, blepharoplast; *c*, chondriosome; *l*, leucoplast; *no*, nucleolus.

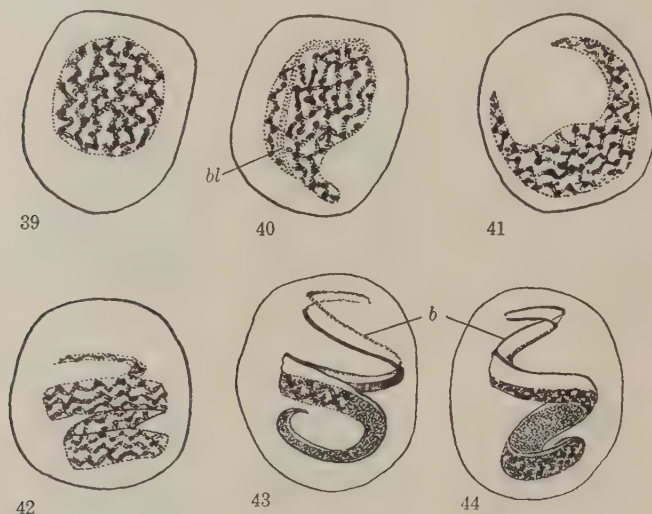
Figs. 27, 28, 29, 31, 32, 34, 35, 38, *Lygodium japonicum* SW.; Fig. 30, *Pteris multifida* POILET; Figs. 33, 36, 37, *Ceratopteris thalictroides* BRONGN.

increase in their number and size, and come to contain starch grains. These starch grains are thrown away during the swimming of the spermatozoid.

The number and size of chondriosomes in the spermatid are almost constant throughout the whole course of the spermatoteleosis. Chondriosomes are thrown away together with the residue of the spermatid-cytoplasm after the extrusion of the spermatozoid out of the spermatid-membrane.

### Nuclear structure during spermatoteleosis

The nuclei of the spermatids are considered to be in the early prophase stage, when compared with those of the prothallium-cell. They are filled with chromatin-substance of thready structure (chromonema) (Fig. 39). The chromonemata become arranged parallel to the long axis of the



Figs. 39-44. Spermatoteleosis in *Pteris cretica* L. var. *albo-lineata* HK., stained with aceto-carmin after fixation with CARNOY'S fluid.  $\times$  ca. 2000. Fig. 39. Spermatid. Figs. 40, 41. Nucleus becomes crescent-shaped. In Fig. 40 the blepharoplast is seen on the surface of the nucleus. Figs. 42, 43. Almost completed spermatozoid. Fig. 44. Completed spermatozoid. Cilia are not shown. *b*, border-brim; *bl*, blepharoplast.

spermatid-nucleus which now takes up a spiral form (Figs. 40-42). As the spermatozoid approaches its completion the chromonemata of the nucleus become gradually indistinct and the nucleus appears to be homogeneous (Figs. 43, 44). In *Pteris cretica* var. *albo-lineata* and

*Adiantum capillus-veneris*, however, even the completed spermatozoid often shows chromonemata in its nucleus.

The nucleus of the spermatid is spherical, at first, then becomes crescent-shaped owing to the elongation of both its ends and later is transformed into the spiral-band (Figs. 40-42).

By the aceto-carmin method the blepharoplast is difficult to be observed in a spermatid, but sometimes it is observed during the course of its development (Fig. 40). The border-brim resembles the nucleus in its stainability and is seen as a rod-like body when stained with aceto-carmin. The cilia-bearing band, however, stains very faintly with aceto-carmin and is hardly observed. In the completed spermatozoid the border-brim and lateral bar are clearly recognized when stained with aceto-carmin (Figs. 43, 44).

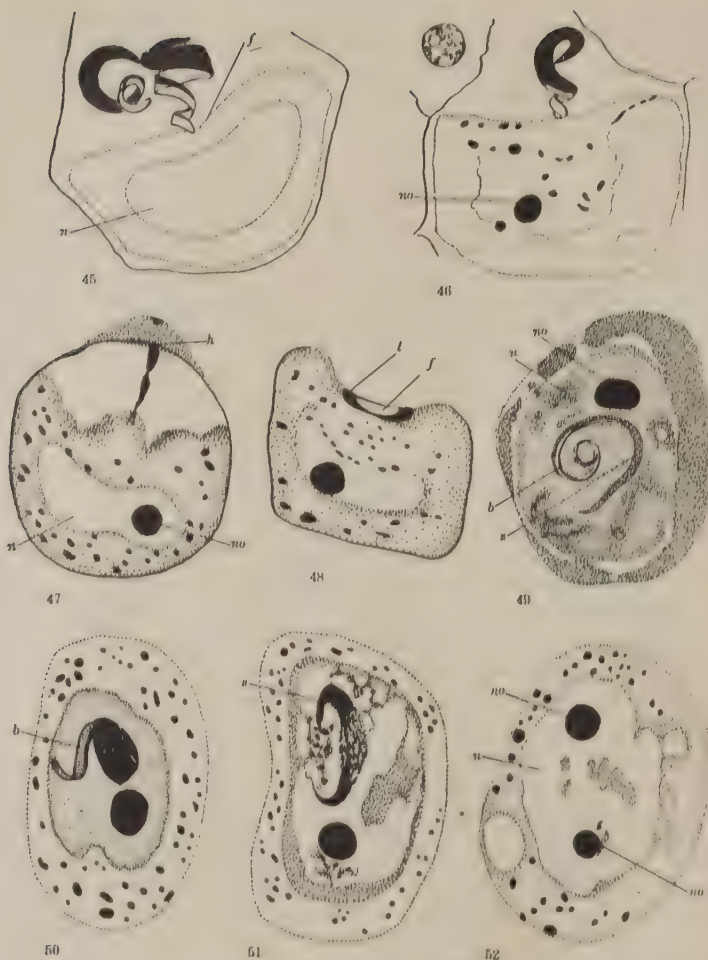
### Fertilization and border-brim

When an archegonium ripens it opens its mouth to receive spermatozooids. The neck-canal and ventral-canal cell are destroyed, and fill the neck portion of the archegonium as mucous substances. The central portion of the mucous substances is composed of destroyed cytoplasm and nucleus etc. around which the cell sap is present. The contacting portion of the egg-cell with the neck portion of the archegonium makes a dent through which the spermatozoid enters into the egg-cytoplasm. This dent is designated as the fertilization-spot (Photo 1, Figs. 48). Sometimes the periphery of the spot stains deeply with haematoxylin (Photo 4, Fig. 48). In some cases when the spermatozoid enters into the egg-cytoplasm a certain amount of the cell sap comes out of the egg-cell through the hole which has been bored by the spermatozoid (Photo 5, Fig. 47).

Though many spermatozooids enter into the neck of the archegonium (Photo 11, Fig. 45) only one of them can penetrate into the egg-cytoplasm (Photo 10) to fertilize the egg, while the remaining ones expire. The cilia are destroyed before the spermatozoid enters into the egg-cytoplasm (Photo 2, 3, Fig. 46). So the spermatozoid without its cilia bores into the egg-cytoplasm and further into the nucleus, but the cilia-bearing band is often destroyed before the entrance of the spermatozoid in the egg-nucleus. Accordingly the spermatozoid in the egg-nucleus is composed of border-brim, lateral bar and nucleus (sometimes also cilia-bearing band) (Figs. 49, 50), and these three (or four) portions completely coalesce with the egg-nucleus.

At first, the size and form of the spermatozoid in the egg-nucleus is distinct, but it gradually becomes faint as the fertilization-process progresses (Photo 6, Figs. 49-51).

The lateral bar and the border-brim possess a certain rigidity (1936), and are not destroyed when the spermatozoid enters into the egg-proto-



Figs. 45-52. Fertilization in ferns, fixed with chrom-acetic acid solution (Figs. 49, 50, 51), BENDA's solution (Fig. 46) or CHAMPY's solution (Figs. 45, 47, 48, 52).  $\times$  ca. 1500. Figs. 45, 46. Spermatozoid just reaches the fertilization-spot. Fig. 47. Some of the egg-cytoplasm comes out of the hole (*h*) which has been bored by the spermatozoid. Fig. 48. The edge (*l*) of fertilization-spot stains deeply. Figs. 49, 50. Spermatozoid which has entered into the egg-nucleus. Border-brim is seen. Fig. 51. Spermatozoid begins to fuse with the egg-nucleus. Fig. 52. Spermatozoid completely fuses with egg-nucleus. *b*, border-brim; *f*, fertilization-spot; *n*, egg-nucleus; *no*, nucleolus; *s*, spermatozoid.

Figs. 45, 46, *Lygodium japonicum* SW.; Figs. 47, 48, *Pteris multifida* POILET; Figs. 49, 50, 51, 52, *Dryopteris oligophlebia* C. CHR. var. *elegans* H. ITÔ.



plasm. These two portions are considered to be the boring apparatus for the egg-protoplasm and can be compared in function with the perforatorium of the spermatozoon of animals.

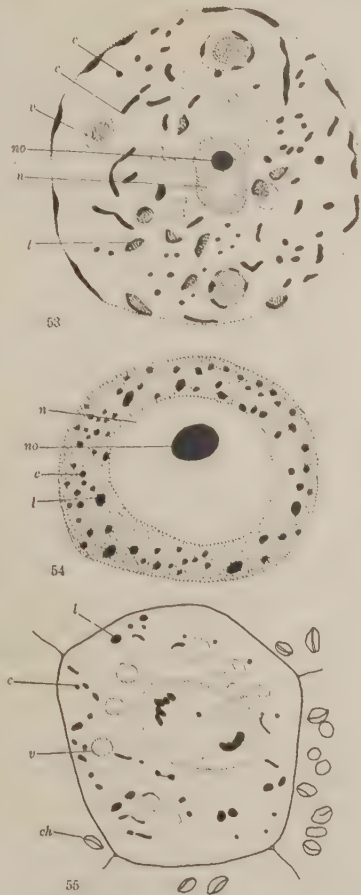
The egg-nucleus contains a large nucleolus before fertilization, but two after the coalescence of the former with the spermatozoid nucleus (Fig. 52). Perhaps it is owing to the physico-chemical reactions of fertilization that one more nucleus should have been produced in the egg-nucleus.

*In fertilization the border-brim, lateral bar and nucleus (sometimes together with cilia-bearing band) come into the egg-nucleus and coalesce with the latter (Fig. 52).*

### Plastids and chondriosomes during fertilization

A young egg-cell contains in its cytoplasm many chondriosomes which are spherical grains or rod-shaped bodies (Fig. 53). Leucoplasts and several vacuoles are also seen in the egg-cytoplasm. In the ripened egg-cell, however, there are few spherical chondriosomes and no rod-shaped ones (Photo 1, Fig. 54). Leucoplasts become smaller and stain somewhat deeply with haematoxylin, but somewhat larger than chondriosomes.

Leucoplasts and chondriosomes are scattered in the cytoplasm of the egg-cell. *In fertilization the spermatozoid comes into the egg-cell after casting away its mother cytoplasm which contains the leucoplasts and chondriosomes, so the leucoplasts and chondriosomes in the embryo-cytoplasm must have originated from those of the egg-cell (Fig. 55).*

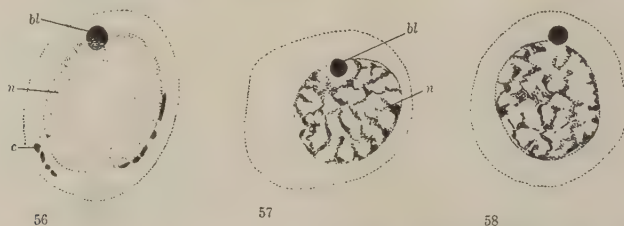


Figs. 53-55. Egg-cell of fern fixed with BENDA's solution (Figs. 53, 55) or CHAMPY's solution (Fig. 54).  $\times$  ca. 1500. Fig. 53. Young egg-cell (*Ceratopteris thalictroides* BRONGN.). Fig. 54. Completed egg-cell (*Dryopteris oligophlebia* C. CHR. var. *elegans* H. ITÔ). Fig. 55. First mitotic division of the embryo (*Lygodium japonicum* SW.) c, chondriosome; ch, chloroplast; l, leucoplast; n, nucleus; no, nucleolus; v, vacuole.

When the embryo begins to develop the leucoplasts gradually increase in number and size, and become green, thus forming the chloroplasts of a new sporophyte.

### Origin of the blepharoplast

The blepharoplast appears, at first, as a spherical body in the spermatid. In spermatogenous mitosis no centrosome is seen at the poles of the spindle when fixation is carried out with chromo-acetic acid solution, CHAMPY's solution, BENDA's solution, FLEMMING's solution or REGAUD's solution, and staining with HEIDENHAIN's iron-alum haematoxylin.



Figs. 56-58. Appearance of blepharoplast in spermatid, fixed with CHAMPY's solution (Fig. 56) or BENDA's solution (Figs. 57, 58).  $\times$  ca. 3000. Fig. 56, *Pteris multifida* POILET; Figs. 57, 58, *Lygodium japonicum* Sw. bl, blepharoplast; c, chondriosome; n, nucleus.

In *Lygodium japonicum* and *Pteris multifida* critical stages are often seen in which the blepharoplast is in the stage of coming out from the spermatid-nucleus (Photo 7, Figs. 56-58). This fact shows the nuclear origin of the blepharoplast.

Judging from the fact that in fertilization the border-brim, lateral bar and nucleus (sometimes together with the cilia-bearing band) enter into the egg-nucleus and coalesce with the latter it is not to be denied that the blepharoplast originates from the spermatid-nucleus.

So that it can be stated that in ferns the blepharoplast originates from the spermatid-nucleus and enters into the egg-nucleus.

Though the blepharoplast originates from the nucleus, it is not necessarily produced from the chromatin-substance. It originates perhaps from the nucleoplasm which is distinct from the chromatin-substance. This point will be discussed in detail later on.

### Discussion

It has been recognized by various authors that in the spermatoteleosis of Pteridophyta a spherical blepharoplast appears, at first, in the cytoplasm of the spermatid. The fact that the spherical blepharoplast elongates

and becomes the blepharoplast of the spermatozoid was shown by BELAJEFF (1898) in *Gymnogramme sulphurea* and *Equisetum arvense*, SHAW (1898) in *Onoclea sensibilis* and *Marsilia quadrifolia*, CAMPBELL (1907) in *Ophioglossum moluccanum*, YAMANOCHI (1908) in *Nephrodium molle*, ARNOLDI (1910) in *Salvinia natans*, SHARP (1912) in *Equisetum arvense*, SHARP (1914) in *Marsilia quadrifolia*, ALLEN (1914) in *Adiantum capillus-veneris* and the writer in *Notogramme japonica* and *Pteris multifida*.

Most of these authors stated that the spherical blepharoplast elongates and becomes linear or rod-shaped, and bears many cilia. YAMANOCHI (1908), however, reported that the blepharoplast develops into a ribbon-like structure and coalesces with the anterior tapering end of the nucleus and that the cilia grow upon the surface of the ribbon-like blepharoplast. According to the writer's observation, however, the elongating blepharoplast differentiates into the deeply stained border-brim which borders its edge and the faintly stained cilia-bearing band upon which the cilia grow. The linear or rod-shaped structure of the blepharoplast is due to the fact either that over-staining has not resulted in the differentiation of the two portions, the border-brim and the cilia-bearing band or that the blepharoplast has been observed in longitudinal section.

That the border-brim, cilia-bearing band and lateral bar as a whole should be designated as the blepharoplast of the spermatozoid has already been proposed by the writer (1934). The cilia develop upon the surface of the cilia-bearing band and not on the border-brim (YUASA, A. 1932, 1933, 1934).

According to ALLEN (1914) in the spermatogenesis of *Adiantum capillus-veneris* and *Aspidium falcatum* the reticulum of the spermatid-nucleus becomes dense, and the nuclear sap is pressed out of the nucleus, resulting in the crescent-shaped, spermatid-nucleus. The writer, however, supposes that owing to the elongation of the blepharoplast some of the spermatid-cytoplasm around the blepharoplast is pushed into the opposite side of the nucleus, and the latter is pressed into the side of the blepharoplast, resulting in the crescent-shape nucleus which makes contact with the blepharoplast.

In every species of fern the blepharoplast coalesces along the whole convex side of the crescent-shaped nucleus of the spermatid, and then in some species the posterior end of the blepharoplast stops elongating and produces the border-brim which occupies about half the length of the spermatozoid, while in another species the posterior end of the blepharoplast elongates together with that of the nucleus, producing the border-brim which occupies the whole length of the spermatozoid. In most of the ferns the anterior end of the nucleus reaches the top of the blepharo-

plast, while in some species (for example, *Notogramme japonica*) the former does not reach the latter, some distance being left between them.

EMBERGER (1922) stated that in *Adiantum capillus-veneris* the chloroplasts in the cytoplasm of the egg-cell become somewhat granular or rod-shaped, pale-coloured and are then difficult to distinguish from the chondriosomes. This description coincides in principle with the writer's observation. In the writer's case, however, the plastids can often be distinguished from the chondriosomes because the former are larger than the latter. According to EMBERGER (1922) the plastids become smaller and cannot be distinguished from the chondriosomes during the course of spermatoteleosis. The writer however, confirmed the fact that the plastids (leucoplasts) in the spermatid-cytoplasm lay up reserve starch-grains in their interior and becomes larger in the course of spermatoteleosis, and that they can be clearly distinguished from the chondriosomes.

In comparison with the nuclei of the prothallium-cell it is recognized that the nucleus of the spermatid is in the prophase stage and is filled with a chromatin-substance of spiral thready structure (chromonemata). This stage of the nucleus never changes throughout the course of the metamorphosis of the nucleus. When the nucleus becomes crescent-shaped the chromonemata, however, arrange themselves parallel to the longitudinal axis of the nucleus. In the almost completed spermatozoid the anterior portion of the nucleus consists only of one chromonema. In the completed spermatozoid the nucleus is in most cases seen to be almost homogeneous with the exception of those of *Adiantum capillus-veneris* and *Pteris cretica* var. *albo-lineata* in which the chromonemata can be recognized in the nucleus of the spermatozoid. A certain amount of the nuclear sap is considered to be utilised in the development of the blepharoplast, resulting thus in the dense accumulation of the chromatin-substance in the spermatid-nucleus. The chromatin-substance in the nucleus of the spermatozoid is densely accumulated, so the chromonemata may not be distinguishable one by one. The dense accumulation of the chromatin-substance in the nucleus of the spermatozoid can be inferred from the fact that the nucleus is always positive to FEULGEN's nucleal-reaction whatever fixative is used for its fixation, and that it stains deeply and homogeneously reddish violet.

In the fertilization of plants only the nucleus of the spermatozoid is considered to enter into the egg-nucleus leaving the blepharoplast in the egg-cytoplasm and fusing with the egg-nucleus as stated by IKENO (1898) in the case of *Cycas revoluta*. ROGERS (1927) also observed in *Lygodium palmatum* that only the nucleus of the spermatozoid fuses with the egg-nucleus leaving the cilia in the egg-cytoplasm. According to the writer's observation, the cilia are destroyed before the spermatozoid bores into the egg-cytoplasm, perhaps in the mucous substances of the neck of the



archegonium. The border-brim, lateral bar and nucleus (sometimes together with the cilia-bearing band) enter into the egg-nucleus. The cilia-bearing band is often destroyed before the entrance of the spermatozoid into the egg-nucleus. Though the cilia-bearing band originates from the blepharoplast and develops while consuming the nuclear sap of the spermatid-nucleus it is rather of cytoplasmic nature (1936 a) and is considered to be the newly formed cytoplasm of the spermatozoid. It is also considered that the cilia-bearing band does not perform important rôle in fertilization other than as the attachment-portion of the cilia. That the border-brim and lateral bar perform the rôle of a perforatorium is suggested by their rigidity.

The entrance of the border-brim and lateral bar into the egg-nucleus suggests that the blepharoplast originates from the nucleus.

As to the origin of the blepharoplast two theories have been advocated. One of these theories is that the blepharoplast originates from the centrosome, and the other that the blepharoplast appears in the cytoplasm *de novo* independent of the centrosome. According to HENNEGUY (1898) and WILSON (1928) the centrosome is a body of double structure which in some cases acts as centrosome and in others as blepharoplast. The fact which affirms the double structure of the centrosome was observed by the writer (1936) in the germination of the spore of *Stemonitis*. In some cases the planocyte of *Stemonitis* changes into a cyst and results in two newly formed planocytes after a mitotic division. In the formation of the flagellum of this newly formed planocyte the centrosome of the previous division remains unchanged and gives rise to the flagellum. On the other hand, in the germination of the spore the blepharoplast comes out of the spore-nucleus and develops the flagellum, while in the formation of the cyst the blepharoplast again disappears into the nucleus, giving up the flagellum.

What is then the origin of the double structure which is composed of centrosome and blepharoplast. According to IKENO (1903) in the spermatogenesis of *Marchantia polymorpha* the centrosome comes out of the nucleus of the spermatogenous cell and becomes, at last, the blepharoplast of the spermatid, after controlling several spermatogeneous divisions. In the case of *Stemonitis* as stated above, the writer (1936) also observed the nuclear origin of the blepharoplast.

In the present case of ferns the centrosome was not observed in the spermatogenous division and the blepharoplast appears for the first time in the spermatid. YAMANOUCI (1908) also observed no centrosomes in the spermatogenous divisions of *Nephrodium molle*. Therefore in ferns the double-structure which is composed of centrosome and blepharoplast is thought to appear only in the spermatid and not to perform any rôle



other than that of the blepharoplast. The origin of the double structure is thought to be the spermatid-nucleus.

The blepharoplast of ferns is always negative to FEULGEN's nucleal-reaction during the course of its development. The blepharoplast (border-brim, cilia-bearing band and lateral bar) shows also a negative nucleal-reaction with the exception of the cases where 3% aqueous solution of potassium bichromate, 2% aqueous solution of osmic acid (fume), corrosive sublimate saturated in water, formalin, LA COUR's solution, REGAUD's solution, JUNGERS' solution or BENDA-EHRLICKI's solution have been used as the fixative (YUASA, 1936a, 1936c). Judging from this fact it is inferred that the blepharoplast contains no thymonucleic acid and that it has no direct relation with chromatin-substance. That the border-brim shows some resemblance in its nature to the nucleus (YUASA, 1936a), however, suggests a relation between the blepharoplast and the nucleus. It is affirmed that the blepharoplast originates from that part of the nucleoplasm which is distinct from the chromatin-substances.

### Summary

1. In the spermatoteleosis of ferns the blepharoplast appears as a little spherical body in the spermatid, and furnishes the spermatozoid with border-brim, cilia, cilia-bearing band and lateral bar. Therefore the border-brim, cilia-bearing band and lateral bar as a whole are designated as the blepharoplast of the spermatozoid. The differentiation of border-brim, cilia-bearing band and lateral bar occurs during the development of the blepharoplast.

2. In the spermatid-cytoplasm there are many plastids primordia (leucoplasts) which gradually lay up reserve starch-grains in their interior and become larger as the metamorphosis of the spermatid progresses. The plastids (leucoplasts) are cast away together with the cytoplasm-residue of the spermatid during the swimming of the spermatozoid. The chondriosomes remain unchanged as regards their number and size throughout the course of the spermatoteleosis, and are cast away on the extrusion of the spermatozoid from the spermatid-membrane or during the swimming of the spermatozoid.

3. The spermatid-nucleus is in the prophase stage and is filled with a chromatin-substance of thready structure (chromonema). The nucleus of the spermatozoid presents a homogeneous appearance, owing to the dense accumulation of the chromatin-substance.

4. In fertilization the border-brim and lateral bar (sometimes together with the cilia-bearing band) enter into the egg-nucleus and coalesce with it.

5. The cytoplasm, plastids and chondriosomes of the spermatozoid are cast away before fertilization; so the newly formed embryo inherits the cytoplasm, plastids and chondriosomes of the egg-cell.

6. The blepharoplast appears first in a spermatid and is thought to originate from that part of the nucleoplasm which is distinct from the chromatin-substance.

The writer wishes to express his sincere thanks to Dr. Y. SINOTÔ of Tôkyô Imperial University for his valuable suggestions and criticism during the course of the work. Thanks are also due to Director Dr. H. HATTORI of Tokugawa Institute for Biological Research who read through the manuscript and gave valuable criticism.

The expenses for the carrying out of this study were partly defrayed out of a grant from the "Nippon-Gakuzyutu-Sinkôkai" (The Japan Society for the Promotion of Scientific Research) to which the writer wishes to express his best thanks.

P.S.—After the arrangement of this manuscript had been finished Dr. A. G. LANG kindly sent the writer a copy of a reprint from the "Journal of the Eliza Mitchell Scientific Society, Vol. 52, No. 2 (1936)" dealing with the subject "Spermatogenesis in *Marsilia*". In this paper he also confirmed the presence of the cilia-bearing band and blepharoplast (the border-brim of the writer) in the spermatozoid of *Marsilia quadrifolia*, and showed that the cilia-bearing band remained in close association with the blepharoplast which was not a single, chromatic rod of matter, but was composed of two identical and parallel structures of material.

Though he stated that the blepharoplast elongated within the spermatid nucleus and was responsible for the final form of the spermatozoid he seemed to support the observation made by the writer (1934) that the blepharoplast itself gave rise to the cilia-bearing band, consuming a certain amount of the nuclear sap.

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## Explanation of plate I

- Photomicrograph 1. Almost completed egg-cell, fixed with CHAMPY's solution. Many chondriosomes are seen in the cytoplasm. (*Dryopteris oligophlebia* C. CHR. var. *elegans* H. Irô)  $\times$  ca. 900.
- Photomicrograph 2. Spermatozoid which has just reached the fertilization-spot, fixed with BENDA's solution. (*Lygodium japonicum* Sw.)  $\times$  ca. 1000.
- Photomicrograph 3. Spermatozoid of which the head has just plunged into the egg-cytoplasm, fixed with BENDA's solution. (*Lygodium japonicum* Sw.)  $\times$  ca. 1000.
- Photomicrograph 4. Completed egg-cell, fixed with CHAMPY's solution. The edge of the fertilization-spot is stained deeply. (*Pteris multifida* POILET)  $\times$  ca. 1000.
- Photomicrograph 5. A certain amount of egg-cytoplasm has come out from the hole which has been bored by a spermatozoid, fixed with CHAMPY's solution. (*Pteris multifida* POILET)  $\times$  1000.
- Photomicrograph 6. Spermatozoid which has entered in the egg-nucleus, fixed with chrom-acetic acid solution. (*Dryopteris oligophlebia* C. CHR. var. *elegans* H. Irô)  $\times$  ca. 1000.
- Photomicrograph 7. Spherical blepharoplast of spermatid, fixed with BENDA's solution. (*Lygodium japonicum* Sw.)  $\times$  ca. 1000.
- Photomicrograph 8. Blepharoplast has made contact at the convex side of the spermatid-nucleus, fixed with chrom-acetic acid solution. (*Athyrium nipponicum* HANCE)  $\times$  ca. 1000.
- Photomicrograph 9. Elongated blepharoplast, fixed with chrom-acetic acid solution. (*Pteris multifida* POILET)  $\times$  ca. 1000.
- Photomicrograph 10. Spermatozoid has just entered into the egg-cytoplasm, fixed with chrom-acetic acid solution. (*Pteris multifida* POILET)  $\times$  ca. 1000.
- Photomicrograph 11. Spermatozooids which are swimming towards the egg-cell through the neck of the archegonium, fixed with CHAMPY's solution. (*Pteris multifida* POILET)  $\times$  ca. 1200.
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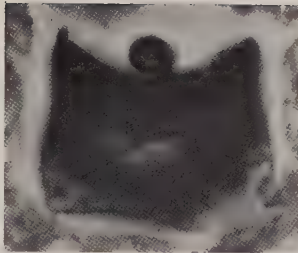




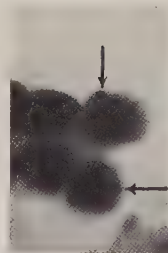
PLATE I



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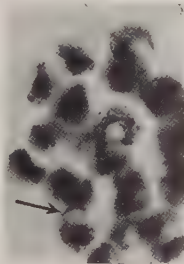
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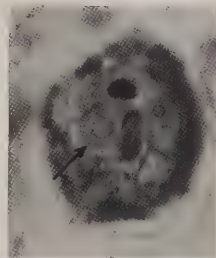
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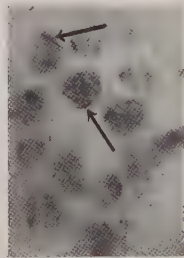
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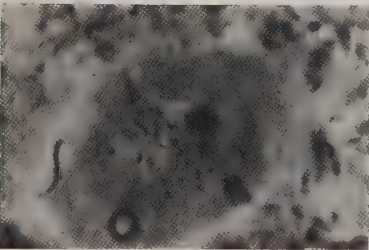
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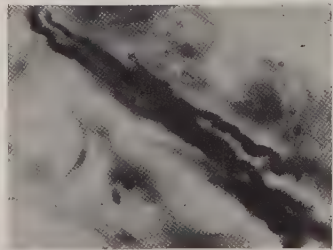
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# Anomalous secondary growth in *Bauhinia japonica* MAXIM.<sup>(1)</sup>

By Tsugio HANDA

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With plate II and 10 text-figures

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(Received May 11, 1937)

The genus *Bauhinia* has long been a subject of many anatomical studies because of its different types of anomalous secondary growth. SCHENCK (1893) divided such growth of *Bauhinia* into three types: 1) winging and waving of the stem, 2) formation of successively younger zones of xylem and phloem, and 3) formation of the so-called cleft xylem-mass. Almost all the studies hitherto published are confined merely to a portion of the stem, but have never been extended to the root, perhaps on account of the difficulties inherent in collecting such a subterranean part. And the descriptions of *Bauhinia*, as regards the anomalous secondary growth, have referred hitherto merely to the completed structures. CRÜGER (1850) and WARBURG (1883) are, however, to be counted as examples of the rare workers who observed both the stem and root in certain species of the present genus. The latter found that the anomaly of the cleft xylem-mass was continuous from the stem to the root, in definite contrast to the case observed by the former.

In *Bauhinia japonica*, nothing seems to have been reported so far concerning the anomalous secondary growth. Fortunately I had good material of the species and have been able to follow the anomalous structure from the stem to the root. The material exhibits in certain parts of the stem a structure of a type which rather belongs to the third type of SCHENCK's classification, though differing in detail rather considerably from it. As in SCHENCK's first type, it is equally waved throughout the somewhat thickened parts of the stem, but not so remarkably winged; and further descriptions of this type seem to be almost unnecessary. Moreover, in this species there are found two other types of anomalous secondary growth, which have not so far been known to us even in any other genera and families, as far as my knowledge goes. On the whole, then, I have met with in one and the same species of *Bauhinia* several types of anomalous secondary growth.

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(1) Contributions from the Divisions of Plant-Morphology and of Genetics, Botanical Institute, Faculty of Science, Tokyo Imperial University, No. 193.

The anomalous structures in question will be developmentally considered by means of making cross sections at different levels of the material. The structure of one and two year old plants will also be referred to.

This paper embodies the report of a part of anatomical studies on climbing plants which are in progress under the guidance of Prof. Y. OGURA, who moreover enabled me to collect the material<sup>(1)</sup>. It is a great pleasure for me to express him my hearty thanks.

## Material and method

The plant at my disposal which had been cultivated in the Bonin Islands was about 3 centimetres thick at the base of the stem. Neither seedlings nor young plants from the same individual were obtainable. And, for reference studies on the development of anomalous structures a few young plants were used which had grown in the southern part of Wakayama-Ken, Japan proper.

The material, as is usual in climbing plants, contains a considerable amount of parenchyma, and is softened sufficiently when treated for an hour or so with boiling water. Whenever permanent preparations were wanted, sections cut from the softened pieces were cleared with 'eau de JAVELLE' and stained mostly with safranin and light green.

## General features of the stem

*B. japonica* is one of the tendril climbers, the leaves of which are alternate in two rows. At first the stem (except the lower part of the trunk) is somewhat cross-shaped in the transverse view (fig. 1, A), and it then becomes gradually flattened owing to the unequal activity of the cambium ring (fig. 1, B). At a more advanced stage such as that shown in fig. 1, C, two wide and two narrow sides are definitely distinguishable, but the wide sides are somewhat curved. As the leaves alternate, the concave and convex sides of the internode also alternate on the stem; and insertion of the leaf and twig takes place always on the convex side at the upper end of an internode. Associated with the flattening, waving of the stem also appears (fig. 1, left), though not in such a remarkable degree as it is known to occur in other tropical species of *Bauhinia*. According to SCHENCK's classification, the flattening (consequently winging) and waving of the stem is an independent type in the anomalous secondary growth. In the present species, this feature is commonly manifested throughout the relatively thickened parts of the stem.

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(1) The expense in collecting materials has been partly defrayed from the Japan Society of Promotion for the Scientific Research.

In somewhat thickened stems (cf. fig. 1, C) the xylem consists of the two parts, the axial and periaxial woods, as is often the case in climbing plants. The ring of axial wood is all around of almost even thickness, while the periaxial wood is far more thickened on the narrow than on the wide sides. The periaxial wood is already divided by the radial bands of parenchyma into several wood-segments. Later the pith also takes part in the formation of anomalous structures. The cells on the margin of the pith

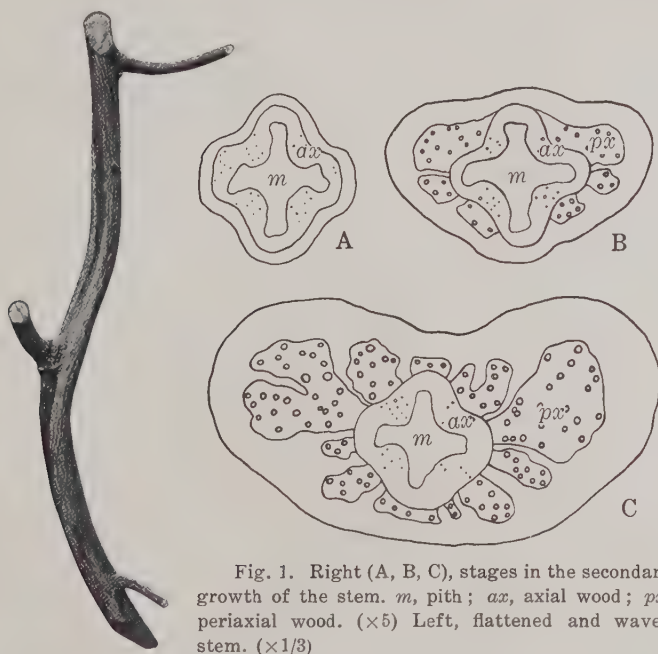


Fig. 1. Right (A, B, C), stages in the secondary growth of the stem. *m*, pith; *ax*, axial wood; *px*, periaxial wood. ( $\times 5$ ) Left, flattened and waved stem. ( $\times 1/3$ )

are far smaller than those occupying the central region. The former are especially small near the groups of primary xylem. However, this is generally the case with many plants, and has no special meaning regarding the formation of anomalous structures.

### Types of anomalous secondary growth

My material presents in one and the same individual three different types of anomalous secondary growth, even after excepting the above-mentioned type of flattening and waving. Here these will be outlined in their typical and completed condition, so as to facilitate the understanding of the details in the later pages.



1) *Cleavage of the axial wood.* The stem is circular in the lowest 20 cm., of which the upper three-fourths exhibit the cleft xylem-mass such as that shown in fig. 2, A. At first the ring of axial wood begins to be cleft by the dilatation occurring in the pith and in the periaxial wood, then the splits thus formed grow wider, mainly owing to the increasing amount of elements of the vascular bundles which have been secondarily formed in that dilatation-tissue.

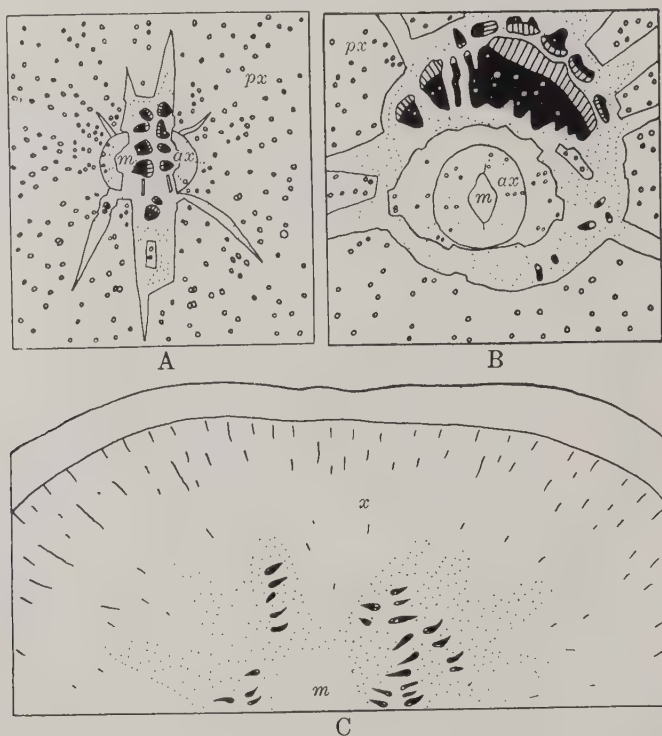


Fig. 2. Types of anomalous secondary growth. A, cleavage of the axial wood of the stem. ( $\times 8$ ) B, bundle-formation around the axial wood of the stem. ( $\times 5$ ) C, bundle-formation in the central region of the root. ( $\times 3$ ) In the bundles formed secondarily in the dilatation-parenchyma (dotted), the xylem and the phloem are shown black and striped respectively; m, pith; ax, axial wood; px, periaxial wood; x, xylem.

In other species of *Bauhinia* it is reported that the cleaving of the wood extends, though quite excluded from the axial wood, right to the outermost region of the periaxial wood, and that the resulting wood-segments, each one separately, develop the cambium around themselves, and

that this cambium produces the xylem on the relative inside and the phloem on the relative outside of the segment. The present material does not show such a cambium at all, and, also as regards the scale on which the splitting takes place it is much inferior to the species cited above, the splits never extending outwards beyond the inner region of the periaxial wood. However, it is likely that the present species also can show such splits and cambium in far more thickened material than the present one.

The cleavage of the axial wood seems to be a feature somewhat characteristic of this species. SCHENCK found such a cleavage in a single stem of *B. Langsdorffiana* BONG., and says that in other species of *Bauhinia* also the axial wood mostly remains intact. In my material this sort of cleavage occurs commonly throughout the relatively lower portion of the stem. In the process of split-formation the most striking feature is that the vascular bundles are borne secondarily on the dilatation-tissue. SCHENCK (1893), in a cross section of *Bauhinia* sp., in fig. 132, pl. K, depicts two small xylem bundles inside the cleft segments of the axial wood. He, however, does not touch on these bundles further.

2) *Formation of vascular bundles around the axial wood.* This type of anomalous growth is found for a length of about 5 cm. immediately above the stem base. Fig. 2, B is a cross section from this part. At first the axial (not strictly separate, but including a portion of the periaxial wood) and periaxial woods become separated from each other by the newly developed dilatation-parenchyma, where several vascular strands of various sizes are subsequently formed; most of the members of which grow larger by the activity of the cambium. Cleavage of the axial wood is not evidenced at all.

3) *Formation of vascular bundles in the central region of the root.* Several roots appear at the stem base. These roots, the main as well as the lateral, are markedly thickened at their basal portions, so that they give themselves a somewhat tuber-like appearance. The central region through such a portion is occupied by the dilatation-parenchyma, which has been formed by the division of both the pith-periphery and the innermost part of the xylem, or by that of the latter alone. In this dilatation-parenchyma there are laid down many small vascular bundles, each provided with cambium (fig. 2, C).

Above the anomalous growth was classified into three types. However, they are closely related to one another. Type 1 becomes type 2, when the formation of the dilatation-parenchyma and the bundle in the former are omitted in the pith, but much intensified around the axial wood. In fact the transition from type 1 to type 2 is observed on the stem at its certain height.

In the case of type 2 the secondary bundles formed in the dilatation-parenchyma are all located entirely outside the axial wood, while those of

type 3 are usually wholly on the inside of the xylem. In spite of this difference in location, the bundles of types 2 and 3 are connected with each other in the longitudinal direction though somewhat indirectly.

### Observations in young plants

In order to make clear the development of anomalous secondary growth, it is desirable to examine many plants in successive stages of development. It was however impossible for me to make such a complete examination, but some young plants were studied for the sake of reference in the interpretation of the anomalous structures of old plants. One and two year old plants, all collected in autumn, were used for such study.

Cross sections in fig. 3 are made at the different levels of a one year old plant, as indicated in the sketch. The plant is swollen in the root, where the pith is much larger, and where the vascular system is far more parenchymatous. Anomalous growth is shown neither in the stem nor in the root.

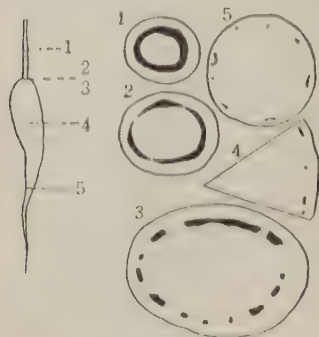


Fig. 3. One year old plant. 1-5, cross sections at the levels indicated. Xylem shown in solid black. ( $\times 8$ )

Fig. 4 illustrates cross sections from a two year old plant. Near the stem base (1), the xylem is thickened enough to form a ring corresponding to the axial wood of old plants. In the transition region (2), the xylem ring is cleft into several segments. It is remarkable that a definite dilatation-parenchyma appears between these segments as well as on the periphery of the pith. Drawings A and B reproduce parts of 1 and 2, each more highly magnified for the sake of detailed comparison. In the swollen portion of the

root (3 and 4), the dilatation-parenchyma is considerably thickened owing to the divisions both in the pith and the innermost region of the xylem.

Below the swollen portion the root is much thinner, and the pith can no longer be distinguished from the xylem-parenchyma, as a central mass of parenchyma containing small groups of the primary xylem is equally divided. Still lower down, the xylem transforms itself into a small solid mass, not leaving any kind of parenchyma in its centre.

The segmentation of wood in fig. 4: 2 may be the first indication of a possible wood-cleaving, which is given its start by the swelling of the root, and which proceeds gradually upwards into the stem. If such a cleaving can actually be the case, then this species adds another mode of formation of the cleft xylem-mass to what will be mentioned later on.

At first the root swells owing to the active production of a considerable amount of secondary xylem which is composed mainly of parenchymatous elements. On the other hand, the parenchyma-cells of both the pith-periphery and the inner part of the xylem divide actively, and, as a result, there is formed a thick dilatation-parenchyma, such as that indicated in

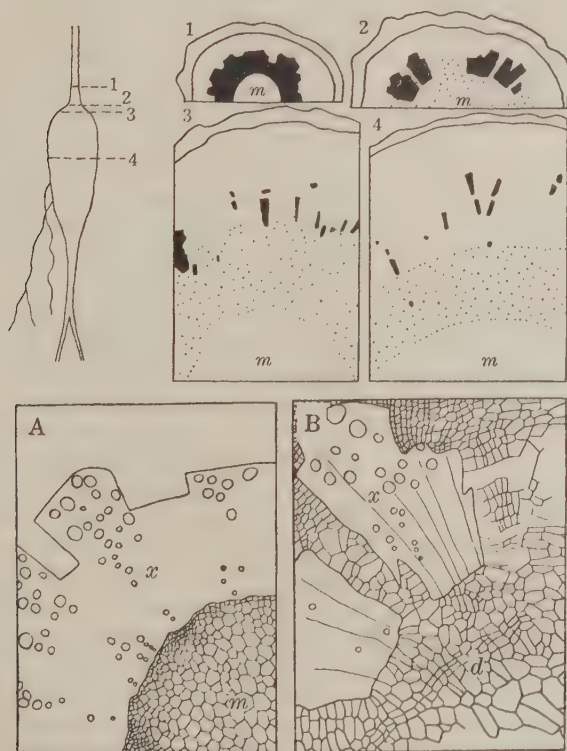


Fig. 4. Two year old plant. 1-4, cross sections at the levels indicated. Pith labeled *m*; dilatation-parenchyma dotted; xylem shown black. ( $\times 8$ ) A and B, parts of 1 and 2, magnified. *m*, pith; *d*, dilatation-parenchyma; *x*, xylem. ( $\times 50$ )

fig. 4: 3 and 4. Perhaps influenced in some way by these divisions in the root, the pith and xylem-parenchyma in the transition region also begin to divide; and at last the xylem ring of this region will come to be split up (fig. 4: 2), and the splits thus arising will extend gradually upwards into the stem.



### Anomalous secondary growth in the stem

In the material sketched in fig. 5, the single line indicates the part showing the anomalous secondary growth designated above as type 1, viz. the cleavage of the wood; the double lines the part showing that of type 2, viz. the formation of vascular bundles around the axial wood; and the triple lines the part showing that of type 3, viz. the formation of vascular bundles in the central region of the root.

In the right branch the anomalous secondary growth of type 1 is not shown below the level a, and it is, besides, interrupted between the levels b and c; in such parts the secondary growth is quite normal. All portions above the level d were not at my disposal.

In the left branch the anomalous growth of type 1 is not interrupted at all, and this anomalous structure passes on upwards, through an intermediate one, to the quite normal structure. As it is thought that this anomalous structure takes its origin from the normal one, and that it extends from below upwards, one may well trace its developmental process by means of examining cross sections cut at successively lower levels. The same can be said with respect to the anomalous growth of type 2. Basing on this idea, the structures at the different levels indicated on the sketch of fig. 5 will be described in the following paragraphs.

Fig. 6 and pl. II, fig. 1 represent cross sections at the level 8. Flattening of the stem, and the differentiation of the concave and convex sides can scarcely be discerned. However, there are some indications of the anomalous growth of type 1, i.e., the wood-segments are separated from the ring of axial wood at the four projecting regions of

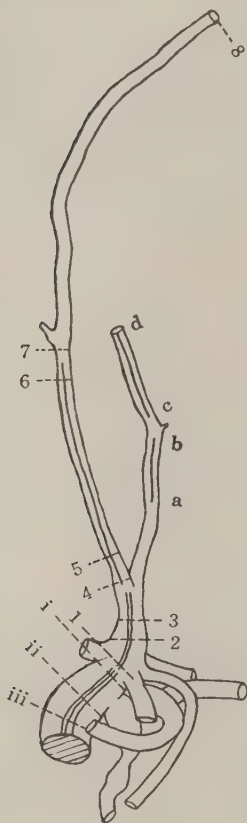


Fig. 5. The present material, numbered at the levels where the following sections were taken. Single, double and triple lines represent the anomalous growths of types 1, 2 and 3 respectively. ( $\times 1/5$ )

the latter, and besides, several narrow splits are formed in the axial wood. Between the ring of axial wood and the separated wood-segments there is found a certain amount of dilatation-parenchyma. On the periphery of the



pith, too, there lies a continuous layer of regularly arranged cells which have been secondarily produced by the division of perimedullary cells. That means, in other words, that marked cell divisions have taken place both inside and outside the axial wood. Hence, the axial wood must have been strongly stretched tangentially, before it formed narrow splits here and there, especially on its four projecting regions. These narrow splits are also short in the longitudinal direction, never running out beyond the limits of an internode.

Though the narrow splits are in scale much inferior to the wider ones which are found in the lower part of the stem, and which will be described later on, both are regarded as being the same as regards their development. Among the narrow splits many are wedge-shaped in the transverse view of the stem. Some of the wedges orientate their apices to the outside and the others to the inside. The parenchyma of the wedges is of medullary origin in the former case, while in the latter case the wedges are filled with the dilatation-parenchyma originating from the parenchyma of the periaxial wood.

The portion 7-8, throughout its length, shows almost the same structure as that at the level 8 just mentioned. Upwards the level 8, the stem continues, for several centimetres at least, to be of the same structure, before it turns quite normal.

The anomalous growth of type 1 is completed at the level 6 and maintained still for a certain length on downwards. By means of serial sections at the levels 7 to 6, this structure can be developmentally considered. Before we enter into details it is convenient to discuss different views hitherto proposed concerning the direction of wood-cleaving in the cross section of the stem.

SCHENCK (1895) found wide radial bands of dilatation-parenchyma in the ring of axial wood in certain species of *Bauhinia*, including *B. Langsdorffiana* BONG. As the structure was in the completed condition, he could not determine whether the initial cells of the bands had entered from the outside or from the inside of the axial wood, or whether from both sides at the same time. He suggests, however, that any mode of these may be the case, on the basis of his observations on the narrow wedges of dilatation-parenchyma of the axial wood in the same species.

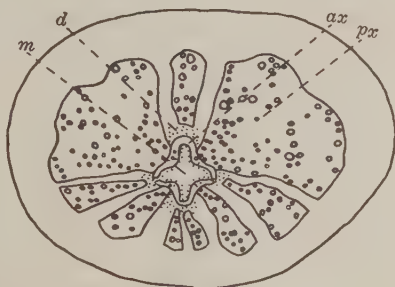


Fig. 6. Cross section at the level 8. *m*, pith; *ax*, axial wood; *px*, periaxial wood; *d*, dilatation-parenchyma. (Cf. pl. II, fig. 1) ( $\times 5$ )

LÖFFLER (1914) tried to solve this problem from the developmental standpoint. He recognized, partly in support of SCHENCK's interpretation, that the cleaving proceeded from the unligified pith outwards into the periaxial wood; however in contradistinction to SCHENCK, he did not recognize that the wood-elements themselves would take part in the forma-

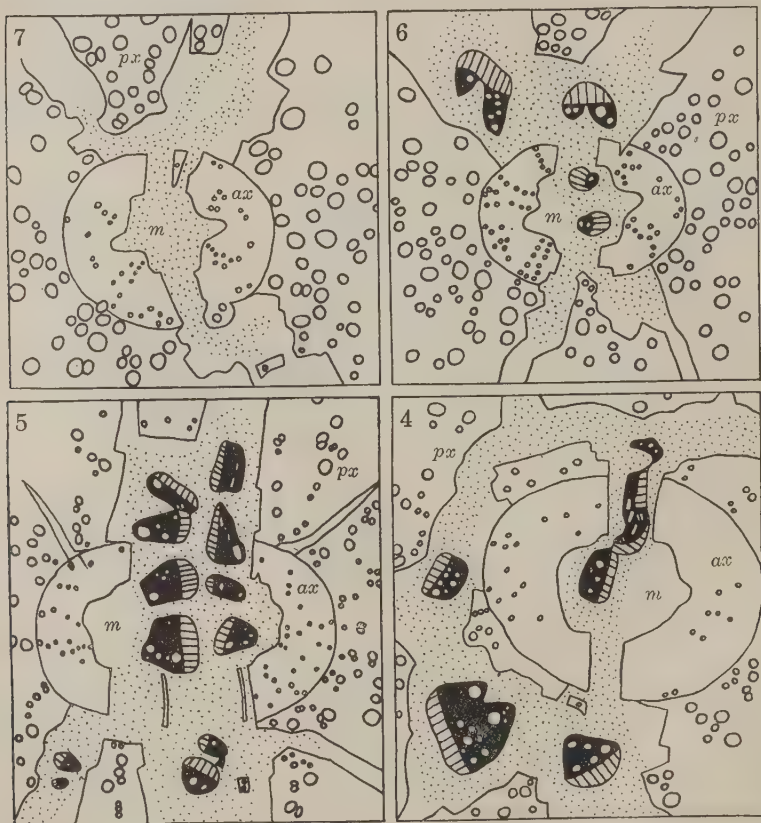


Fig. 7. Parts of sections at the levels 7 to 4. Numbers indicate the levels (fig. 5) at which the sections were made. Dilatation-tissue dotted; xylem and phloem of the secondarily formed bundles shown black (except spaces of vessels) and striped respectively. *m*, pith; *ax*, axial wood; *px*, periaxial wood. (All  $\times 15$ )

tion of splits; nor, in opposition to WARBURG (1883), that the newly formed parenchyma would break from the cortex inwards into the wood. PREIFFER (1926) says that, even from purely mechanical reasons, it is not at all probable that the cleaving arises exogenously.

In *B. japonica*, so far as the present material is concerned, the two wide splits of the ring of axial wood are made to arise by the dilatation of parenchyma in the pith as well as in the periaxial wood, just in the same manner as was described above concerning the formation of the narrow wedge-shaped splits of the axial wood. The initial cells of the splits may be sometimes of medullary, sometimes of periaxial origin. Even in one and the same splits, the initial cells enter at one level from the outside, and at another from the inside of the axial wood. But, it is never observed that the elements of the axial wood themselves take part as the initial cells of the splits.

On either of the flattened sides of the stem the axial wood becomes provided with one split extending through the length of many internodes. The dilatation occurs not only within the two splits of the axial wood, but also in the pith as well as in the periaxial wood; and finally it gives rise to a long continuous band of dilatation-parenchyma, as seen in the cross section of the stem. This band, however, does not lengthen beyond the inner region of the periaxial wood, and never comes in contact with the parenchyma of the cortex. Therefore, such an invasion of the newly formed parenchyma from the cortex inwards into the wood as was reported in *Bauhinia* by WARBURG, cannot of course have taken place in my material.

Fig. 7 illustrates cross sections from different levels of the stem. The numbers of these and the succeeding sections correspond to those of the levels indicated in fig. 5. Such a stage as that explained just above is seen in fig. 7: 7. The dotted area represents the dilatation-parenchyma. Though in this section the dilatation-parenchyma encloses a part of the pith and a fragment of wood, this is not always the case, and another section from a slightly different height may show that there the dilatation-parenchyma is entirely homogeneous, without containing any other kind of tissues.

Small vascular bundles, each provided with both xylem and phloem, soon become differentiated in the dilatation-parenchyma. Then the cambium arises between the two components of the bundles, and the bundles grow progressively larger by means of the cambium. This stage is represented in fig. 7: 6. In the newly formed bundles the xylem and the phloem are shown black and striped respectively; and the dilatation-parenchyma is dotted. (This mode of indication is also employed in the following figures). The bundles in question anastomose with one another in their longitudinal course; moreover the xylem parts of these are connected here and there with the periaxial wood. In one and the same bundle the relative position of the phloem and the xylem is not constant: when the phloem is at one level on a given side of the xylem, then at another level the former may be located on any side of the latter.

Down the stem, this anomaly becomes gradually more conspicuous; the fully advanced stage is illustrated in fig. 7: 5 and pl. II, fig. 2. The splits of the axial wood have become far more widened, and the bundles in the dilatation-parenchyma are more markedly evident both in their number and in the degree of their development. Most bundles in the central region are arranged in two rows, in such a manner that the phloem of one row is opposed to that of the other.

Below the level 5, this marked structure disappears rather suddenly; some of the bundles within the ring of axial wood end blindly below, and the others pass out through the splits, so as to unite with the bundles on the outside of the ring; and at last the ring is closed. Fig. 7: 4 represents the stage just before the closing of the ring.

Though the anomalous growth of type 1 is exhibited in my material only for a short distance above the stem base, it seems that this anomalous structure would extend further upwards, if the plant were left living. On



Fig. 8. Parts of sections at the levels 3 and 2. (cf. pl. II, fig. 3) ( $\times 5$ )

the other hand, any portion of the stem may be influenced to produce this anomalous structure, whenever it is strongly twisted or bent by external forces. However, it can not be thought that the basal portion of the stem has particularly suffered such forces, and so we can not accept external forces as the only cause of the anomalous growth. After all it can only be said that the basal portion appears to be most liable to show the anomalous growth, even when it does not suffer the effect of any such external forces.

Now we turn our attention to the anomalous secondary growth of type 2. This anomalous growth begins to appear at the height of the stem, where the anomalous growth of type 1 is still in process of disappearance, as is recognizable by referring to fig. 7: 4. On the outside of the axial wood the dilatation-parenchyma increases greatly in extent, and several vascular bundles are secondarily differentiated.



Lower down, the dilatation-parenchyma becomes better developed all around the axial wood, and the bundle-system there becomes furthermore considerably strengthened. In fig. 8: 3 and pl. II, fig. 3, the larger bundles, which have already arisen at far higher levels, are arranged in one row; and their cambium produces the xylem to the inside and the phloem to the outside. Moreover, outside the row there are several, much smaller bundles, the cambium of which, in contrast to that of the larger ones, produces the xylem to the outside and the phloem to the inside. In the downward direction the smaller ones, too, grow larger by the activity of the cambium. In fig. 8: 2, they are connected side by side, so as to give another row of bundles. Further, bundles of different sizes are scattered in the dilatation-parenchyma around the axial wood, as can be seen in fig. 8: 2 and 3. Such a structure is maintained down to the level just above the transition region.

### **Anomalous secondary growth in the transition region and root**

The part 1—i (fig. 5) is the so-called transition region, because the structural transition from the stem to the root occurs there. The transition of the anomalous growth from type 2 to type 3, also, takes place in this part. At first, in order to gain preparatory knowledge concerning the anomalous structure in the transition region and root, cross sections at different levels are diagrammatically illustrated in fig. 9. When the sections 1 and 2 are compared, it is noted in the former that the pith is larger, the ring of axial wood is cleft, and that the secondarily formed bundles in the dilatation-parenchyma are much disturbed in arrangement. In the section i, the pith reaches its greatest dimension, the axial wood has disappeared, and the bundles are again regularly arranged. Here the structure is quite of the root nature. Still further downwards the pith becomes smaller and at last completely disappears (ii, iii).

The details will be described by referring to the sections in fig. 10. The ring of axial wood begins to be cleft near the level 1 (fig. 10: 1); and slightly lower down, the resulting parts become further cleft into fine cords and are then dispersed outwards. The bundles formed in the dilatation-parenchyma are also dispersed outwards. Many fine cords thus arising, together with those of the periaxial wood, constitute a very complicated system of anastomosis in the transition region. At the lower end of the transition region, namely at the level i (fig. 10: i and pl. II, fig. 4), the secondarily formed bundles are again regularly arranged in the dilatation-parenchyma, which has been produced perhaps by the division of both the medullary margin and the innermost part of the normal wood. Thus the anomalous growth of type 3 begins to make its appearance.



At the level *i* the dilatation-parenchyma is located on the inside of all the normal wood, which is far more parenchymatous and contains small, scattered groups of tracheae, though at higher levels that tissue was observed entirely outside the axial wood, a part of the normal wood. And, it may generally be said that the bundles of the anomalous growth of type 3 are differentiated completely inside the whole of the normal wood, but that those of the anomalous growth of type 2 are laid down between the axial and periaxial woods.

It is necessary to add here that the bundles of the anomalous growth of type 3 are differentiated at first as so many small ones and then grow larger by means of the cambium. This is also true in the case of the anomalous growth of type 2.

Still further downwards, the arrangement of the bundles becomes gradually more disturbed (fig. 10: ii). In fig. 10: iii, the pith is not found at all, and the central region of the root is occupied exclusively by the dilatation-parenchyma, which must have been formed by the division of wood-parenchyma alone, but without any participation of pith-parenchyma. Throughout the dilatation-parenchyma there are scattered many small bundles of secondary origin which anastomose with one another. The same structure is maintained down to the lower end of the tuber-like portion of root, except that the amount of dilatation-parenchyma decreases gradually downwards. Further down, the root has an almost normal structure. Fig. 10: A is a cross section from such a part. In



Fig. 9. Diagrammatic cross sections from successively lower levels (fig. 5). *m*, pith; *ax*, axial wood; *px*, periaxial wood; *x*, xylem; *c*, centre of the root.

the center of the section, only a small amount of dilatation-parenchyma can be seen.

As is shown above in fig. 5, several lateral roots appear at the base of the stem. Of these some are thickened like so many tubers, and the rest have a normal appearance. The former present quite the same anomalous growth as the main root; the latter also produce some amount of dilatation-parenchyma, which subsequently gives rise to small vascular bundles. In general the anomalous growth of the root of normal appearance is in degree and extent far inferior to that of the tuber-like ones.

It is quite necessary to consider in what way the anomalous growth

of type 3 is derived from the normal structure shown in the main root of young plants. In the earlier pages dealing with a two year old plant it was pointed out that the dilatation-parenchyma in the transition region

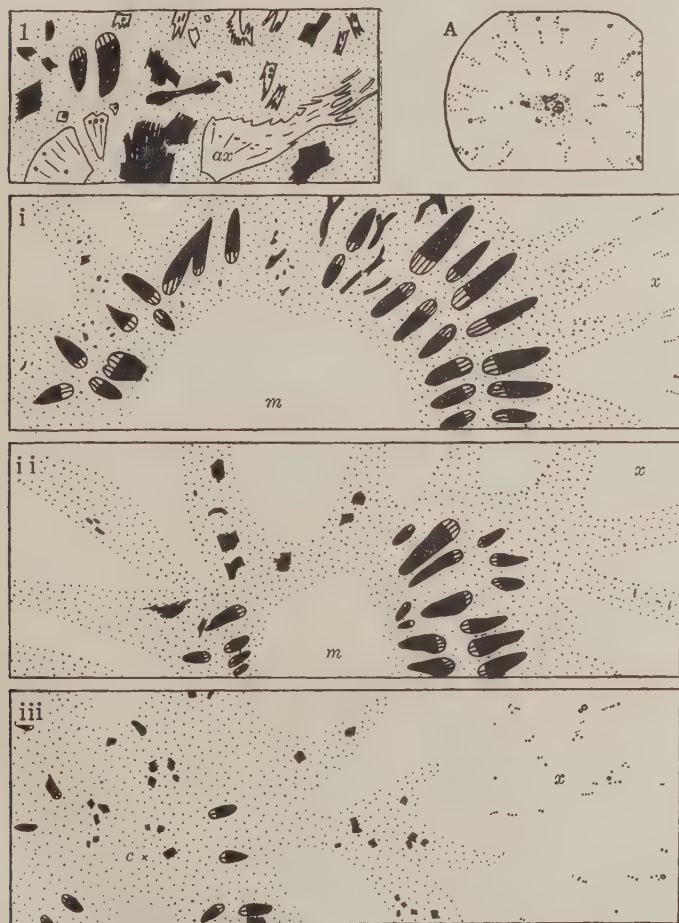


Fig. 10. Parts of sections of the transition region and root. Mode of indication and lettering as in the foregoing figures. A, section through a far thinner part of the root. (All  $\times 5$ )

and root was formed by divisions either in both the innermost part of the xylem and the medullary margin, or else in the former alone. The dilatation-parenchyma of such roots and that of thickened roots, are both

regarded as being the same in origin. In young roots the dilatation-parenchyma will gradually increase in amount, as they grow thicker and longer. At a more advanced stage, vascular bundles will begin to arise in the dilatation-parenchyma, and ultimately the anomalous growth of type 3 will be completed.

Generally the anomalous growth of type 3 becomes differentiated as one goes down the root or towards the younger part of it. However, the alternative has not been determined, whether the anomalous growths of types 2 and 3 arise separately, and later become connected through the transition region, or whether they have a common origin about the transition region and from this level the anomalous growth of type 2 becomes differentiated upwards and that of type 3 downwards.

### Summary

(1) In one and the same individual of *Bauhinia japonica*, three different types of anomalous secondary growth are distinguishable.

(2) In the anomalous secondary growth of the first type, the central area of the stem is split up by the dilatation of the pith as well as of a certain region of the wood, then in the parenchyma thus formed there arise several vascular bundles which become soon provided with cambium. This anomalous growth is shown in certain parts of the stem, not far above the stem base.

(3) In the anomalous growth of the second type, the axial and periaxial woods become separated from each other by the development of dilatation-parenchyma between them. Subsequently, small vascular bundles become differentiated in the dilatation-parenchyma, where they are arranged generally in two rows around the axial wood. The cambium of the inner row, in the usual manner, produces the xylem on the inside and the phloem on the outside, while that of the outer row produces the two components in the inverse orientation. This anomalous growth is shown for a certain length immediately above the stem base.

(4) The anomalous growth of the third type is shown in the roots, especially in the tuber-like ones. At first, active cell-division occurs both in the pith and the innermost region of the xylem, and thus the central area of the root becomes occupied exclusively by the dilatation-parenchyma. Then in this tissue many vascular bundles are differentiated, the arrangement and behavior of which are the same as those described for the anomalous growth of the second type.

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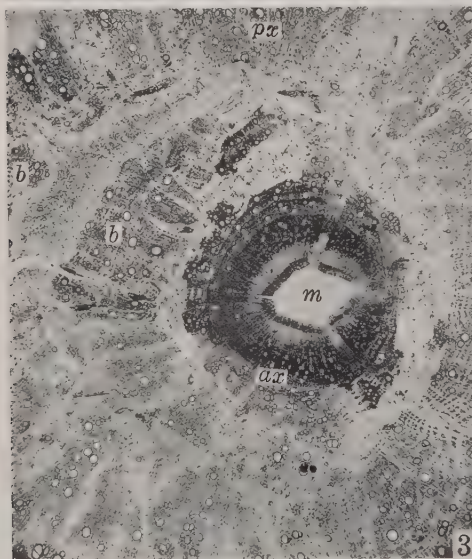
## Explanation of plate II

Abbreviations: *m*, pith; *ax*, axial wood; *px*, periaxial wood; *b*, bundles formed in the dilatation-parenchyma.

- Fig. 1. Cross section at the level 8 (text-fig. 5). The dilatation-parenchyma is seen both inside and outside the ring of axial wood, which has just commenced to be cleft here and there. (Cf. text-fig. 6) ( $\times 15$ )
- Fig. 2. Cross section at the level 5, showing the anomalous growth of type 1. (Cf. text-fig. 7: 5) ( $\times 20$ )
- Fig. 3. Cross section at the level 3, showing the anomalous growth of type 2. (Cf. text-fig. 8: 3) ( $\times 9$ )
- Fig. 4. Part of cross section at the level i, showing the anomalous growth of type 3. (Cf. text-fig. 10: i) ( $\times 12$ )









# *Ranzania japonica* (Berberidac.). Its morphology, biology and systematic affinities

By Masao KUMAZAWA

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With 6 text-figures

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(Received May 11, 1937)

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The berberidaceous genus *Ranzania* is monotypic and endemic in Japan, occurring in the very limited parts of the northern Hondo, approximately from 36°40'N. to 39°50'N.

*Ranzania japonica* T. ITO grows usually associated with *Caulophyllum*, *Cimicifuga* etc. in the deciduous forest of the mountain-side as one of the plants of the sciaphilous type. It grows in places which are about 700–1000 metres above the sea-level and usually rich in humus. The sun does not, as a rule, shine directly upon the plant in the growing season.

The plant was first introduced as a new species of *Podophyllum* by ITO (MAXIMOWICZ, 1886) at the time of its discovery, but soon afterwards a separate genus was established for this species by the same author (ITO, 1888). Although the genus is clearly distinguished from any other genus of the Berberidaceae and is included in the tribe Epimediaceae, yet the systematic affinities are obscure, for no detailed morphological or biological studies of this interesting plant do not exist at present except the ITO's original description and the TISCHER's very brief morphological notes (1902).

Since in the course of his morphological studies of the families Ranunculaceae and Berberidaceae, the present writer has had the opportunities to study this species on cultivated materials, detailed descriptions of its morphology and anatomy, together with the discussion on its systematic affinities, will be given below.

## I. External morphology

### A. THE AERIAL ORGAN

In the full-grown condition, the aerial stem is erect, 20–50 cm. in height and 5–8 mm. in diameter at its base. It has several scales at its base and two cauline foliar leaves, which are apparently opposite to each other at its top. The ternate foliar leaf has a long petiole; each leaflet with the long rachis has 3–5 lobes.

The peduncle is 3–5 cm. long, 1 mm. in diameter when the flower opens, but after that it usually elongates in some degree, and in the extreme case reaches 15 cm. in length when the fruits are ripe. Three to five, rarely seven, peduncles seem to be fascicular at the top of the aerial stem, i.e. between the bases of the two cauline foliar leaves. From that part, one rudimentary leaf with a simple or bipartite lamina often develops besides the two foliar leaves. This leaf has no stipules, while the two foliar leaves have the lateral stipules (fig. 1,  $S_1$ ,  $S_2$ ) which are scaly and 1–2 mm. long in the full-grown condition, while the petiole of the radical leaf has the ventral stipules.

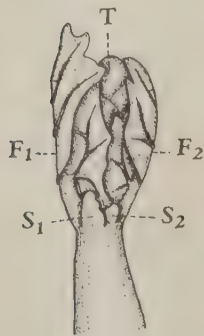


Fig. 1. The young aerial stem just sprouting from the winter bud. The inflorescence (T: terminal floral bud) is protected by the laminae of two cauline leaves  $F_1$  and  $F_2$ .  $S_1$  and  $S_2$  are the lateral stipules of  $F_1$  and  $F_2$  respectively. ( $\times 3$ )

The aerial stem, peduncles and cauline leaves are erect in the winter bud and sprout in this state. The vernation is rather simple: two lateral leaflets and the terminal one of each cauline leaf overlap one another, the terminal one being situated at the extreme outside, and the ventral surface of both lateral leaflets adaxial.

The inflorescence is enveloped and protected by two cauline foliar leaves on both sides (fig. 1). Even when the aerial stem elongates and

flowers come to open, the foliar leaves are not yet perfectly unfolded, which takes place first after the blooming just as in the case of *Epimedium*.

One peduncle (fig. 4, A;  $T_8$  or  $T_{10}$ ) is formed in the axillary part of each of the cauline leaves, and each peduncle has, at its base, a few very

rudimentary bracts; in the axillary part of each bract a floral bud without peduncle is discerned at the very early stage of the ontogeny. The floral bud just mentioned often develops into the flower in the vigorous plant, but is usually very rudimentary, 0.5–1.0 mm. in diameter, and never develops further. One rudimentary bract is always discerned also on the terminal peduncle, although it can not be usually seen at the later stage. The bract may often develop into the petiolated foliar leaf with a small lamina (the 10th leaf in fig. 4, A) in some individuals as already mentioned. From the axillary part of this bract or rudimentary leaf, one peduncle (fig. 4, A: T<sub>10</sub>) appears, on which the flower is borne. Therefore, four flowers usually come out on a single erect stem.

## B. THE FLORAL ORGAN

Flowers, each 3 cm. in diameter, are rather beautiful. According to the previous authors, the floral elements are trimerous and alternate to one another, petaloids being 3 + 3, stamens 3 + 3, carpel 1. The perianth-leaves, except petaloids, were described as three in number, being small, green and fugacious, but according to the present writer's observation, the perianth-leaves or bractlets, fugacious and green, are always 3+3. The outermost three of these perianth-leaves are so rudimentary that they might be overlooked as done by the previous authors.

The petaloids are rather large and beautifully light-violet. Petals are oval in shape, 4–5 mm., being lobed at their top (fig. 2, B). Two thick and fleshy nectaries are found on the ventral surface near the base of the petals.

Each nectary is oval, situated on the lateral nerves of the petal. Such a petal having fleshy nectaries on the lateral nerves is also found in *Berberis* and *Mahonia* (fig. 2, A), but never in the herbaceous genera of the Berberidaceae.

Regarding the stamens, the writer has found two interesting characters which have hitherto been overlooked.

Firstly: the movement of the filament caused by the stimulation just as in the well-known case of *Berberis* or *Mahonia*. From the histological point of view, the epidermal cells on the dorsal side of the filament are papillous and sensitive to the stimuli, quite similar to the case of *Berberis*. Among the berberidaceous genera, the irritability of the fila-

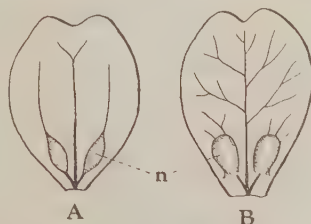


Fig. 2. A: The petal of *Berberis Thunbergii* DC. var. *Maximowiczii* FRANCH. et SAV. Ventral surface. B: The petal of *Ranzania*. Ventral surface, n: fleshy and massive nectaries on the lateral nerves. ( $\times 6$ )



ment has hitherto been known only in *Berberis* and *Mahonia*, and it is very interesting from the various view points that a third example has been found in the herbaceous genus *Ranzania*.

Secondly: the special type of the anther-dehiscence. According to the text-book of systematic botany, the anther of the Berberidaceae is classified into two kinds regarding the mode of dehiscence, the one, with the valve—all the genera except *Podophyllum* and *Nandina*, and the other, with the longitudinal slit—*Podophyllum* and *Nandina*.

The writer has examined the mode of dehiscence in each of the following genera, and found that two types are clearly distinguishable in each of two kinds, as follows:

The anther with valves	Type I	<i>Berberis</i> , <i>Mahonia</i> , <i>Epimedium</i> , <i>Caulophyllum</i> , <i>Achlys</i> , <i>Plagiolegma</i> ( <i>Jeffersonia</i> ), <i>Diphylleia</i>
	Type II	<i>Ranzania</i>
The anther with longitudinal slits	Type I	<i>Podophyllum</i>
	Type II	<i>Nandina</i>

In *Berberis*, dehiscence occurs longitudinally in the lateral part of anther where the ventral and dorsal loculi are connected, and also in the part where the wall of the dorsal loculus is connected to the connective on the dorsal side, as shown by the dotted lines in fig. 3, A<sub>3</sub>; thus four valves, two of which hang down from the top of the anther, and the other two are connected laterally to the ventral side of the connective, are found in a single stamen (fig. 3, A<sub>1</sub>, A<sub>2</sub>, A<sub>4</sub>). At a later stage, the two valves hanging down from the top of the anther roll up, and twist themselves so as to make their inner surfaces look towards the adaxial side of the flower.

The mode of dehiscence is quite the same as in *Berberis* in the genera *Mahonia*, *Caulophyllum*, *Epimedium*, *Plagiolegma* (*Jeffersonia*), *Achlys* and *Diphylleia*.

In *Ranzania*, however, dehiscence occurs both in the part where two ventral loculi of anther come near to each other on the ventral side of the connective and on the dorsal side of the anther precisely corresponding to the case of *Berberis* as shown in fig. 3, B<sub>5</sub>; thus in this genus a single stamen has two valves hanging down from the top of the connective (fig. 3; B<sub>1</sub>, B<sub>2</sub>, B<sub>7</sub>). At a later stage, the connective elongates further and the valves roll up. Then a single stamen makes one think that it had only one large valve, whose inner surface looks towards the abaxial side of the flower (fig. 3; B<sub>3</sub>, B<sub>4</sub>).

The dehiscing part of anther in *Nandina* is shown by dotted lines in fig. 3, C<sub>1</sub>, and its longitudinal slit in fig. 3, C<sub>2</sub>.

All the members of the Ranunculaceae including *Paeonia*, *Glaucidium* and *Hydrastis* are, except a few insignificant respects, similar to *Nandina* as regards the mode of anther dehiscence.

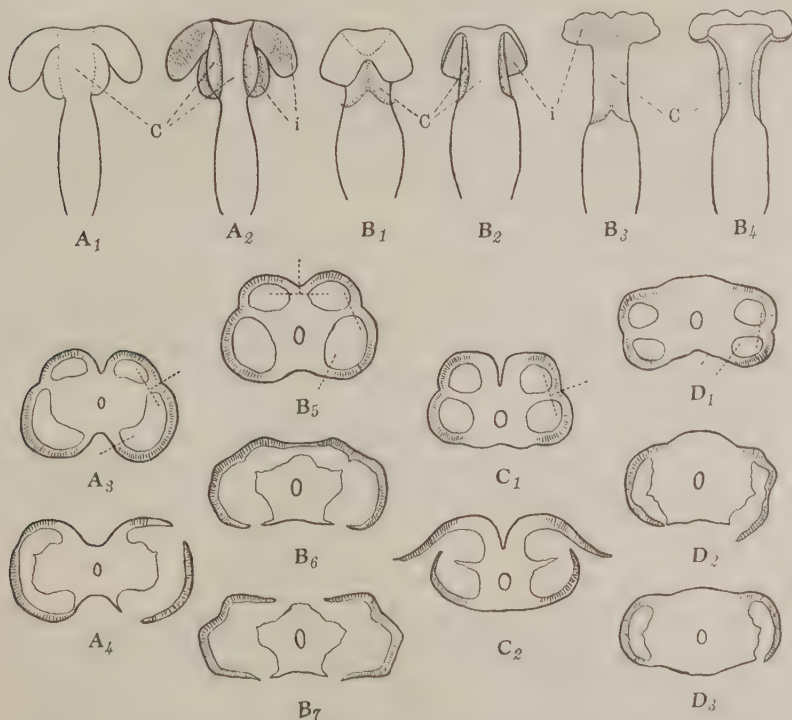


Fig. 3. The modes of dehiscence of anthers in *Berberis*, *Ranzania*, *Nandina* and *Podophyllum*. A<sub>1</sub>-A<sub>4</sub>; *Berberis Thunbergii* var. *Maximowiczii*. B<sub>1</sub>-B<sub>7</sub>; *Ranzania*. C<sub>1</sub>-C<sub>2</sub>; *Nandina*. D<sub>1</sub>-D<sub>3</sub>; *Podophyllum peltatum*. D<sub>3</sub>; *Podophyllum pleianthum*. A<sub>1</sub>, B<sub>1</sub> and B<sub>3</sub>; the ventral view of the stamen. A<sub>2</sub>, B<sub>2</sub> and B<sub>4</sub>; the dorsal view of the same. B<sub>3</sub>, B<sub>4</sub>; the stamens in the later stage than B<sub>1</sub> and B<sub>2</sub> respectively. C: connective of the stamen. i: inner surface of the valves.

The diagrammatic cross sections of the anther indicate the dehiscing parts which are shown by dotted lines, and reticulately thickened tissue which contributes to the dehiscing mechanism. The upper part of each figure corresponds to the ventral side of the anther.

*Podophyllum* is also described as having the anther with the longitudinal slit, but the part where dehiscence occurs differs from what we see in *Nandina*, as is shown in fig. 3, D<sub>1</sub>. In *Podophyllum peltatum* (fig. 3, D<sub>2</sub>), the mechanical layer composed of the reticulately thickened cells is discontinuous in the lateral part where the ventral and dorsal

loculi come near to each other, while in *Podophyllum pleianthum* (fig. 3, D<sub>2</sub>) which is often treated as a separate genus distinct from *Podophyllum* (WOODSON, 1928; KUMAZAWA, 1936 b), the mechanical layer is quite continuous in the cross section of the anther.

The modes of dehiscence seem to correspond to the systematic position of the genera, for the genus *Nandina* was treated by NAKAI (1936) as a representative of a separate family Nandinaceae, and *Podophyllum* was also separated by some authors from the Berberidaceae as a member of the Podophyllaceae. The special type of dehiscence in *Ranzania* is, therefore, one of the highly significant characters in considering the systematic affinities of the genus.

The pollen grain of *Ranzania* is characteristic in structure among the berberidaceous genera as is shown in the previous paper<sup>(1)</sup> of the writer (1936 a).

The carpel somewhat resembles that of *Berberis* or *Mahonia* in external view. The fruits are of baccate nature, containing numerous seeds which are elongated in shape, the seeds being 3 mm. in length and brown in colour.

Since the detailed structure of the carpel, placenta and ovule, as comparison with that of other berberidaceous members, is to be described by the writer in a separate paper, the description concerning them will be omitted here.

### C. THE GEOPHILOUS ORGAN

The rhizome is not typically horizontal, but somewhat erect, 5–7 mm. in diameter. One monopodial axis elongates about 1–2 cm. under ground and terminates in the aerial stem with flowers, then the largest axillary bud, situated at the top of the monopodial rhizome, usually, but not always, elongates in the next year: the whole rhizome, therefore, is often irregular in branching mode and shape. The monopodial axis of the rhizome elongates usually in one year only and its internodes are very short: but its rather small axillary bud elongates in a few years in the monopodial manner, or the axillary bud, deeply situated in the ground, elongates rather upwards monopodially as a slender rhizome which is about 3 cm. long, 3.5–4 mm. in diameter, having the internodes of several millimetres long.

The numerous adventitious roots appear from the rhizome close to one another. They are usually uniform and less than 1.5 mm. in diameter.

(1) A correction may be made here. In the paper treating the pollen grain morphology of the Berberidaceae and allied families, the pollen of *Bongardia Roumef.* C. A. MEY. was described and figured. But at present the writer has found that the species treated in the paper as *Bongardia* was, in reality, *Leontice altaicus* PALL.

The young root and rhizome are yellow, but they become brown at the later stage.

#### D. THE PHYLLOTAXY AND THE WINTER BUD

The fertile winter bud (fig. 4, A and B) consists of 5–10 scales. At its centre one aerial stem with primordial flowers is found already in late summer or early autumn of the first year. Each of the scales has an axillary bud, of which those more internally situated are usually larger than those more externally situated. In the vigorous buds (fig. 4, A) the innermost axillary bud, embraced by the seventh scale in the figure, is also

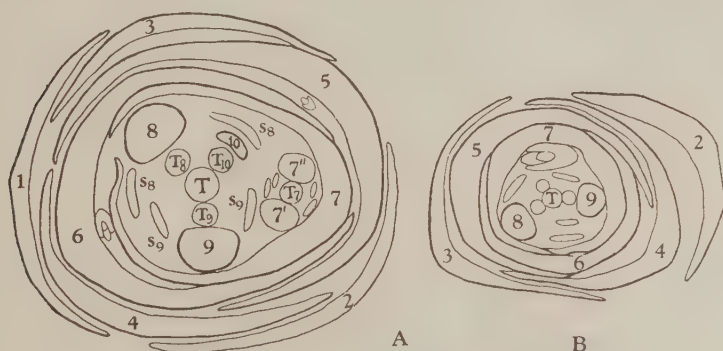


Fig. 4. Diagrams showing the cross sections of the fertile winter bud. A and B; vigorous and slender winter buds respectively. The axillary bud embraced by the seventh leaf indicated by 7 in the figure is represented by the aerial stem in A, by the sterile bud in B. 1-7: scale leaves of the winter bud, the first one is lacking in B. 8-9: cauline leaves. 10: small cauline foliar leaf which may often develop in some individuals, otherwise it is reduced to a rudimentary bract. T: terminal peduncle. T<sub>8</sub>-T<sub>10</sub>: axillary peduncles embraced respectively by the cauline leaves or bract denoted by 8, 9 and 10 in the figure. T<sub>7</sub>: terminal peduncle of the axillary bud embraced by the scale indicated by 7. 7', 7'': cauline foliar leaves on the axillary erect stem. S<sub>8</sub>, S<sub>9</sub>: lateral stipules on the cauline foliar leaf 8 or 9.

represented by an aerial stem with flowers which will open in the second year, i.e. in the same year as the flowers on the terminal aerial stem; in this case the axillary bud embraced by the sixth scale in the figure may usually develop to form the new sympodial rhizome. When the axillary bud is not represented by an aerial stem (fig. 4, B), it may produce a single radical foliar leaf, rarely two, or may not produce any foliar leaf at all in the second year, and terminates in an aerial stem with flowers in the third year. The axillary buds, except those mentioned above, are dormant and usually do not produce any foliar leaf in the second year.



The phyllotaxy of *Ranzania* was supposed by TISCHLER (1902) to be of  $\frac{1}{2}$  divergence, but examining the cross section of the fertile winter bud, we find that the scale leaves and the cauline foliar leaves are all spirally arranged, somewhat deviating from the typical  $\frac{2}{5}$  divergence (fig. 4, A). In some winter bud (fig. 4, B) the divergence is larger than in the case of the former example and scales are arranged in the spirally wound  $\frac{1}{2}$  divergence. In the seedling as later described (fig. 6, C), the approximately typical  $\frac{1}{2}$  divergence changes gradually to a smaller one. Therefore, the view of SCHMIDT (1928) that the original phyllotaxy of the berberidaceous genera is represented by  $\frac{1}{2}$  divergence seems to be supported also in the genus *Ranzania*. Further the present writer's view (KUMAZAWA 1936 b) that the  $\frac{1}{2}$  divergence of opposite or alternate foliar cauline leaves in some genera of the Berberidaceae and Ranunculaceae may be ontogenetically derived by a modification of the spiral phyllotaxy is also confirmed in *Ranzania*.

## II. Internal morphology

### A. THE AERIAL STEM AND PEDUNCLE

The internode of the aerial stem is hollow, and the ring of the mechanical sheath is found to be several cell-layers thick (fig. 5, A; m).

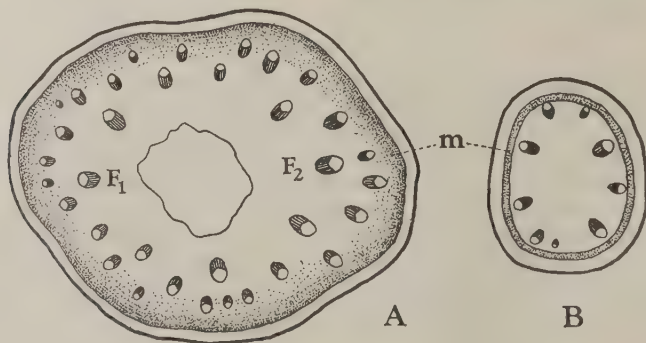


Fig. 5. Cross sections through the aerial stem and peduncle. A; the aerial stem. B; the peduncle.  $F_1$ ,  $F_2$ : the trace bundles of the midribs of two cauline foliar leaves respectively. m: the fibrous cylinder. ( $\times 14$ )

Between the epidermal layer and the external surface of the sheath, there are either no parenchymatous cells at all or less than three cell-layers of the parenchymatous tissue. The internal boundary of the sheath is not evident, for its cells become parenchymatous gradually as they draw inwards.



The vascular bundles, arranged in two irregular cycles, are 20–40 in number in the basal cross section of the aerial stem (fig. 5, A), the medullary ones being somewhat larger. Some of the peripheral small bundles are embedded into the mechanical sheath.

The fascicular cambium is so inactive that the secondary elements are rarely produced; nevertheless, the leaf trace bundles have some amount of secondary xylem-elements at the nodal region.

The xylem is V-shaped and rather similar to that of the most herbaceous genera of the Ranunculaceae or Berberidaceae in its histological structure.

The endodermis or starch sheath is not evident.

The vascular bundles of the peduncle, 8–11 in number, are arranged almost in a single cycle (fig. 5, B), and the bundles are not embedded in the mechanical sheath. The xylem does not show the typical V-shape. The boundary between the mechanical sheath and the parenchymatous tissue of the pith or cortex is very evident. In other respects, the histological structure of the peduncle is similar to that of the aerial stem.

## B. THE RHIZOME

The rhizome is solid and the pith is occupied by the parenchymatous cells. The hypodermal sclerenchymatous tissue is not observed, but some cells with thickened and lignified walls are often found scattered in the cortex. No crystals are found in any tissue, and the endodermis or starch sheath is not visible.

The phellogen is subepidermal in its origin, and a small amount of cork layers is produced.

The circular cambium produces some amount of the secondary tissue which forms a hollow cylinder with or without several narrow gaps. The part of the gap corresponds to the primary ray tissue and consists of the parenchymatous cells with thick or thin walls. The secondary ray tissue is never produced.

In the cross section, the vessels are found as the small patches embedded in the above-mentioned lignified secondary tissue which consists mostly of substitute fibres or thick-walled parenchymatous cells. No typical xylem parenchyma is observed. The secondary vessel-segments are short spindle-shaped, having simple perforations and the scalariform pits.

## C. THE ADVENTITIOUS ROOT

The root system of the adult plant is adventitious in its origin. The epidermis of the root usually peels off early, and thus exposed cells are elongated radially, the wall being cutinized. The cortex is paren-

chymatous and does not show the secondary thickening growth. The endodermal cells are thin-walled, both the radial and tangential walls are cutinized, the latter less so than in the former.

The central cylinder is about  $3/7$  of the root proper in diameter, and the xylem is usually tetrarch, rarely tri- or pentarch in the root of the first order. The primary xylem consists of the several vessels. The protoxylem in the early stage of the root is adjacent directly to the single layer of the pericycle, which changes soon after to the cambium. This cambium produces about ten secondary vessel-segments towards inside at the part adjacent to the secondary phloem, and several layers of sclerenchymatous cells towards the external and lateral sides of the primary xylem. The pith is occupied by the small cells with thick walls. Then the central cylinder of the well-developed root is all occupied by lignified thick-walled cells except the phloem and a few cell-layers of cambium; thus it is not easy to distinguish the xylem area from the other tissues of the central cylinder.

The root of the secondary order, having the diarch xylem, is simple in histological structure, containing a smaller amount of the lignified cells than those of the first order.

#### D. THE LEAF

The petiole of the radical leaf is nearly round in cross section and unifacial in structure, while that of the cauline foliar leaf is somewhat dorsi-ventral, but also unifacial in structure; the vascular bundles are about 20 in number, some being medullary.

In its histological character, the petiole much resembles the aerial stem.

The upper epidermis of the lamina consists of cells of the irregular polygonal outline in surface view, and the lower one, of cells of the wavy outline. The surface of the epidermis is smooth and the cuticle is scarcely developed on both surfaces. The stomata are simple in structure and distributed only on the lower surface. The mesophyll consists of 6–8 cell-layers; the upper 2–3 layers consist of flattened, not palisade cells and have little or no intercellular space. The fact that the mesophyllar differentiation is not sufficient, seems to be correlated with the habit of this genus as the sciaphilous plant.

#### E. THE VASCULAR COURSE

The course or behaviour of the medullary bundles in *Ranzania* is somewhat different from that of the other genera of the Berberidaceae and allied families studied by the writer (1930 a, 1930 b, 1932 a, 1936 b, 1937).

As already described, the peduncle of this genus has about 10 bundles arranged in a rather regular cycle and no typical medullary bundles are found (fig. 5, B). If traced downwards in the successive cross sections, each of these bundles of the terminal peduncle divides into several pieces and migrates outwards at the node of the cauline leaves. At the same time, many trace bundles of each cauline leaf migrate inwards, arranged in two irregular arcs, one rather internally and the other rather externally. Then the small bundles from the terminal peduncle fuse into the greater part of these leaf trace bundles and lose their individuality at the same nodal region. Therefore, all the bundles, both peripheral and medullary, observed at the base of the erect stem, may be regarded as the trace bundles of the two cauline foliar leaves; and the so-called cauline bundles, which descend from the peduncle to the stem base without anastomosing with any other bundles, are not found in this genus, contrary to the cases of *Podophyllum* and *Diphylleia* (compare KUMAZAWA 1930 b, 1936 b).

The radical foliar leaf sends three or five trace bundle groups to the rhizome tri- or pentalacunarly. The floral vascular course should be mentioned below. The trace bundles of three perianth-leaves, belonging to the outermost whorl, are unilacunar in their vascular origin, and are not lobed, while those belonging to the second whorl are always unilacunar and each trace is lobed into three afterwards. The large petaloids and the small petals with nectaries are similar to each other in their vascular supply. Their vascular behaviour and origin are not constant also in a single flower, and are 1) unilacunar and three-lobed, 2) trilacunar or 3) bilacunar, one of the lateral nerves fusing with the midrib.

Tracing the bundles of the peduncle upwards by means of the successive cross sections, we find that each of them divides, and some of them become cortical at the top of the peduncle or at the base of the floral receptacle. One of these cortical bundles is divided further and one of thus divided bundles enters into the perianth of the outermost two cycles, the rest into petals or stamens on a higher level. Into the petaloid, one of the normal bundles enters directly as the midrib, and some of the cortical bundles, observed in the lower part of the receptacle, enter as the lateral nerves if the petaloid is bilacunar or trilacunar in its vascular supply. The vascular distribution in the gynaeceum will be described in another paper.

### III. Seedling characters

The seed sown in autumn germinates in early spring of the next year. In the first year of germination, the assimilating organs are represented by one or two foliar leaves besides the cotyledons (fig. 6, A). The cotyledonary lamina, 8–9 mm. long, oval or slightly asymmetric in shape,

emerges perfectly from the seed-coat, and the cotyledonary petioles are slender, 10–15 mm. long, quite free to each other. The hypocotyl is erect and 10–15 mm. in length.

The first leaf element of the seedling is small and always foliar, its lamina being kidney-shaped, ternately compound or often imperfectly bi- or tripartite. The second leaf element is scaly or foliar, though the writer could not decide which will be the normal case. The third and

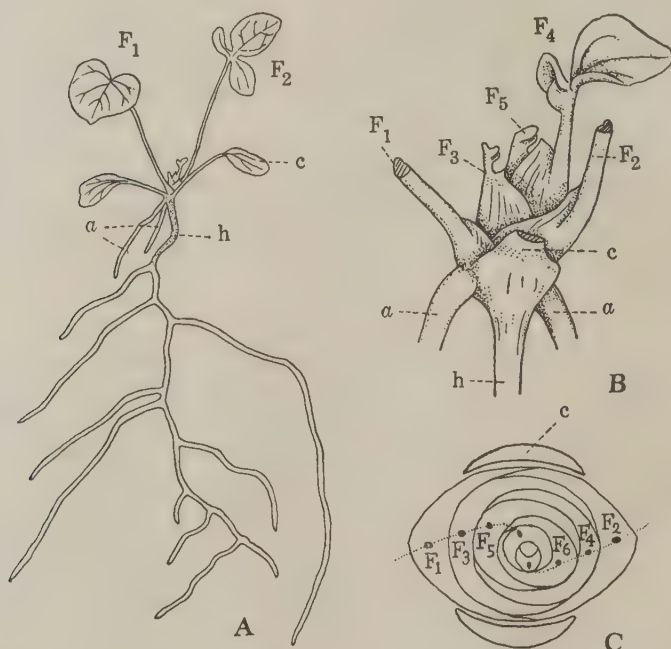


Fig. 6. A; the seedling in the first summer of its germination. The type with two foliar leaves. ( $\times 1$ ) B; the epicotylar and hypocotylar regions in the seedling shown in A, more highly magnified. C; Diagram showing the phyllotaxy of the seedling above figured. F<sub>1</sub>, F<sub>2</sub>: foliar leaves. F<sub>3</sub>, F<sub>4</sub>, F<sub>5</sub>.....: scale leaves forming the first winter bud. c: cotyledon. h: hypocotyl. a: adventitious root.

later leaves are always scaly with or without rudimentary laminae, constituting the first winter bud (fig. 6, B). The phyllotaxy in the first year seedling changes gradually from the typical  $\frac{1}{2}$  to the spiral arrangement (fig. 6, C). The root system is well developed, but most roots are primary in their origin, and a few adventitious roots appear first from the cotyledonary node.



The seedling in the second year of its germination has usually a single radical foliar leaf, whose shape much resembles that of the adult plant, but is smaller. The hypocotyl becomes horizontal, being correlated with the development of the adventitious roots.

In the third year seedling, an axillary bud on the small rhizome often produces a single foliar leaf besides that from the terminal bud. The young plant produces an aerial stem with flowers first in the fourth year after its germination in the well-developed individual. The rhizome elongates usually in monopodial manner until the erect stem is produced.

#### IV. Systematic affinities

When the genus *Ranzania* was established, ITO (1888) believed that the genus is a transitional type between *Podophyllum* and *Diphyllia*. From the morphological and biological studies of vegetative and floral characters, TISCHLER (1902) considered that the genus *Ranzania* has, without doubt, the nearest affinities to *Leontice* (including *Caulophyllum*) and *Epimedium*. This view seems to have been adopted by PRANTL (1897). According to MIYAJI (1930) who studied the chromosome phylogeny in the family Berberidaceae, *Caulophyllum*, *Ranzania* and *Epimedium* contain 8, 7 and 6 haploid chromosomes respectively, and have the same caryotype different from that of the other genera of the family. Further considering the fact already noticed by TISCHLER (1928) that the genus *Epimedium* has the largest number of the species and the widest geographical distribution among the genera of the tribe Epimediaceae, MIYAJI came to the conclusion that *Epimedium* may be phylogenetically the youngest genus derived from *Caulophyllum* through *Ranzania* by the elimination of chromosomes. The basic number of chromosomes such as 7 is not found in the Berberidaceae except in *Ranzania*. The haploid number 14 is found in *Berberis* and *Mahonia* alone, but MIYAJI considered that *Berberis-Mahonia* may not be derived from *Ranzania*, for their respective caryotype is somewhat different from that of the latter.

According to the present writer's study, *Ranzania* seems to be nearer to *Leontice-Epimedium*, and especially to *Caulophyllum*, than to the other genera of the Epimediaceae, when viewed from the stand-points of morphological and biological characters of the vegetative organs, so that the view of TISCHLER or MIYAJI seems to be supported. But it is a most interesting fact that the view is not supported if the floral structure is considered. The irritable stamen, the petal with massive fleshy nectaries at its base, the baccate nature of the fruit are never found in the Epimediaceae, but are found in the Berberideae. These characters are systematically



significant and may not be understood without assuming some close connection of this genus with *Berberis-Mahonia*.

The placenta of *Berberis* or *Mahonia* is described as basilar, and that of *Ranzania* as parietal, but the differences are, in reality, not quite fundamental, and both types may be regarded ontogenetically to be the parietal placenta. On this point the writer will discuss in another paper.

The dehiscing type of the anther and the structure of the pollen grain in *Ranzania* differ from those of both Berberideae and Epimedioae, but the structure of the pollen grain with thin extine seems rather akin to that of the Berberideae than to that of the Epimedioae as already noticed (KUMAZAWA, 1936a).

The writer is of the opinion that the genus *Ranzania* resembles in its vegetative structure more closely *Caulophyllum-Epimedium* than the other herbaceous genera of the Epimedioae, but the gap between the two is far larger than hitherto believed, and that the genus is very closely connected in the floral characters with the Berberideae and seems to be a rather separate type derived equally from both tribes and much further deviating from the Epimedioae than hitherto believed.

## V. Summary

1. *Ranzania* is a monotypic genus, occurring in the very limited area of Japan and grows on the inclined ground under deciduous forest of the mountain-side.

2. Two cauline foliar leaves are apparently opposite at the top of the aerial stem. These have the unifacial petioles and lateral stipules. The radical leaves have the ventral stipules.

3. The peduncles seem to be fascicular at the top of the erect stem, but the inflorescence is of cymose nature. The axillary peduncles have the rudimentary bracts at their early stage of development. Small green perianth-leaves or bractlets which fall early, are always 3 + 3, contrary to the previous descriptions.

4. The rhizome is not typically horizontal, but somewhat erect and irregular in appearance. The monopodial axis is short and terminates in an aerial stem with flowers. The axillary bud, destined to terminate in an erect stem in the next year, is usually, but not always, embraced by the uppermost scale leaf of the monopodial axis.

5. The fertile winter bud consists of 7–10 scales and of a terminal axis which terminates in an aerial stem in the next spring. The axillary bud, embraced by the innermost scale of the winter bud, often terminates also in an aerial stem with flowers in the same year in the vigorous individual. In this case no radical leaves are produced from the winter bud. The vigorous sterile winter bud produces usually a single radical

leaf, rarely two. The primordial aerial stem and foliar leaves are erect in the winter bud and sprout in that condition.

6. The scales and the cauline foliar leaves within the winter bud are spirally arranged in somewhat deviating  $2/5$  or  $1/2$  divergence, although the two cauline leaves are quite opposite in the full-grown condition. The phyllotaxy in the seedling is changed gradually from the typical  $1/2$  to the spirally wound one. In this genus the spiral phyllotaxy seems to be derived from the typical  $1/2$  as in some genera of the Berberidaceae and Ranunculaceae.

7. The vascular bundles, 20–40 in number, are arranged in two irregular cycles in the aerial stem, those of the peduncle about 10 in number, in a single cycle. Tracing downwards, it will be seen that the peduncular bundles anastomose with the trace bundles of the cauline leaves at the node, and then lose their individuality; therefore, all the bundles, peripheral as well as medullary, found at the base of the stem, are regarded as the trace bundles of the cauline foliar leaves. The floral vascular course has also been traced.

8. The histological structures of the vegetative organs have been described: they seem to have some resemblance to those of the other genera of the Epimediaceae.

9. The structure and development of the seedling have been examined. In the first year of its germination it produces two small cotyledons with free petioles and one or two foliar leaves. It comes to bloom in the fourth year or later after the germination.

10. Considering the morphological or biological characters, *Ranzania* bears some resemblance to the genera of the tribe Epimediaceae, particularly to *Caulophyllum-Epimedium* as already suggested by the previous authors. Nevertheless, the characters of reproductive organs, particularly the shape and structure of the petals with fleshy nectaries, the nature of the sensitive stamen, the baccate nature of the fruit are quite, and the thin extine of the pollen grain is somewhat, similar to the tribe Berberideae, but the type of dehiscence of the anther is quite unique and different from any other genera of both Berberideae and Epimediaceae. It is, therefore, concluded by the writer that the genus *Ranzania* may be a rather separated type derived from the tribes Berberideae and Epimediaceae, and much further deviating from the Epimediaceae than hitherto believed.

The writer wishes to acknowledge his indebtedness to Professor Y. OGURA of the Imperial University of Tokyo for his valuable advice throughout the course of the work and also to Mrs. S. TAKAHASI and M. KURONUMA of Yamagata Prefecture for their kindness in collecting some of the materials used for this study.

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# Cyto-genetical studies on *Oryza sativa* L. III

## Spontaneous autotetraploid mutants

### in *Oryza sativa* L.<sup>(1)</sup>

By Toshitaro MORINAGA and Eiji FUKUSHIMA

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With 50 text-figures

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(Received May 25, 1937)

In 1932, E. NAKAMORI discovered a tetraploid mutant of rice among the  $F_4$  progenies of a varietal cross Wase-shinriki  $\times$  Kyo-asahi. A tetraploid plant was also found, in the same year, by K. ICHIJIMA among the offspring of rice plants which were raised from seeds treated with X-radiation. The general characteristics and the behaviour of the chromosomes of those autotetraploids have been briefly reported by the discoverers (7, 2). Since 1933, the authors have found, in succession, several such tetraploid plants, together with a tetraploid variety. The results of the studies on those materials were reported briefly at the eighth annual meeting of the Genetic Society of Japan (6). The present paper is intended to describe those results more in detail.

### Occurrence of autotetraploids

**TETRAPLOID I.** One highly sterile *gigas* plant, which was found in 1933 among the  $F_4$  population ( $F_1$ -138) of a sterile hybrid Aioi  $\times$  Tanko-hoira<sup>(2)</sup>, was proved to have 48 chromosomes in contrast with 24 in the normal diploid. This tetraploid plant produced by seeds next year 28 plants of appearance similar to itself, of which 11 plants, chosen at random, were subjected to microscopical examination. In 5 plants 48 chromosomes were clearly counted, and in the others ca 48 chromosomes were also observable, though not so clearly. From those tetraploid plants, 7 tetraploid lines, in total 63 individuals, were produced in 1935. The original tetraploid plant was propagated the following spring to 15 individuals by division, and out of the seeds produced by those clonal plants other 45 tetraploid plants were raised in 1935. Fig. 1, one of the clonal

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(1) Contributions from the Institute of Agronomy, Kyushu Imperial University. No. 58.

(2) The hybrid between two geographical varieties *japonica* and *indica*.

plants in 1934, shows the typical appearance of the tetraploid rice plant in its maturity.



Fig. 1. Tetraploid I in maturation ; a photograph of one of the clonal plants in 1934 showing the typical appearance of the autotetraploid.

**TETRAPLOID II.** The authors have endeavoured over many years to collect in living condition various varieties of rice of different origin, and now more than 1280 varieties or races are under cultivation. A variety



"Shoshikawari-taikwato" sent from the Experimental Station at Saga has been cultivated, without receiving any special notice since 1922. In 1934, its gigantism and sterility caught the authors' attention, and 17 out of 18 plants then cultivated were examined microscopically. Twelve plants possessed 48 chromosomes, 3 plants 47, and in 1 plant 49 chromosomes were counted. The remaining plant also possessed ca 48 chromosomes. Five hundred and twenty one *gigas* plants were raised the next year from the seeds of those plants. Comparing the size and shape of the original



Fig. 2. The hulled and unhulled grains of Tetraploid II (Shoshikawari-taikwato); the specimens of 1921 (upper two rows) and the specimens of 1935 (lower two rows).  $\times 1.4$

seed specimens of 1921 with the seeds harvested in 1935, the authors could ascertain that the variety was already of the tetraploid nature when it was received (Fig. 2). It is regrettable that no record whatever about this variety is preserved at the Saga Station.

**TETRAPLOID III.** The authors have collected from farmers' field more than one hundred specimens of highly sterile diploid individuals. One of those plants,  $S_4$  in 1933, produced the next year 114 offspring, of which 100 were normal diploid, 1 was sterile diploid, while the remaining 13 were of tetraploid appearance. Forty eight chromosomes were counted in 4 plants selected at random out of those 13 plants. Six tetraploid lines, in total 11 plants, were raised in 1935 from the seeds of those tetraploid individuals. The one sterile diploid above mentioned produced only normal diploids in the next generation.

**TETRAPLOID IV.** Another sterile diploid plant of the same collection, S<sub>139</sub> in 1933, produced the next year 48 offspring, of which 6 were normal diploid, 2 were sterile diploid, while the remaining 40 plants were of tetraploid appearance. Fourteen plants were selected at random out of these 40, and 48 chromosomes were counted in 7 plants, and ca 48 chromosomes were observed in others. Fifteen tetraploid lines, in total 67 plants,



Fig. 3. Comparison of diploid and tetraploid plants; the original diploid stock treated in a young stage with chloral hydrate, fertile and sterile tillers produced are shown separately (right); a diploid plant raised from a seed of the sterile tiller (middle); a tetraploid plant (Tetraploid V) raised from a seed of the sterile tiller (left).

were raised in 1935 from the seeds of those tetraploid plants. Two sterile diploid plants in 1934 produced only normal diploids in the next generation.

**TETRAPLOID V.** The authors tried, in 1933, various treatments on rice plant to induce any artificial mutations. One plant treated in a young stage with chloral hydrate produced many highly sterile tillers (96.6% sterility) besides normal ones. One plant out of a few, which were raised next year from the seeds of those sterile tillers, possessed 48 chromosomes showing corresponding appearances. This tetraploid plant produced 3

tetraploid individuals in the following year. The original stock preserved produced again many sterile tillers (84.4% sterility) in 1934, and from the seeds produced by them 24 tetraploid plants were freshly raised in 1935. Fig. 3 shows the original stock with sterile tillers, and the normal and tetraploid plants produced from the seeds of the sterile portion.

**TETRAPLOID VI.** A highly sterile plant, which was by mistake regarded in 1933 as a triploid, produced the next year 4 offspring. Of those 4, 1 was a normal diploid, 1 possessed 48 chromosomes, and in the remaining 2 plants ca 48 chromosomes were observable. Two tetraploid lines, in total 5 plants, were obtained in the following year from the seeds of those tetraploid individuals.

### Morphological characters of tetraploids

To make concrete ideas of the morphological characters of tetraploids, the authors measured the materials from all sources to obtain the knowledge of the height of the plant, the length of the ear, the number of ears per plant, the diameter of the culm, the length and width of the leaf-blade, and the number of spikelets per panicle. Various measurements indicating the size of the hulled and unhulled grains were also taken. Three diploid lines respectively comparable to Tetraploid III, IV and V were also measured in the same manner. The results are summarized in Tables I and II.

The tetraploid plant is somewhat stunted, the height being reduced on the average to about 4/5 of the comparable diploid. Owing chiefly to the shortness of the stalk, the panicle of the tetraploid often fails to come entirely out of the sheath (Figs. 1 and 3). In these two points the tetraploid plant offers a clear contrast to the triploid. The length of the tetraploid ear may be slightly greater than that of the diploid.

The number of ears per plant is reduced markedly in tetraploid, though, on account of its sterility, many tillers are produced secondarily in vain (Fig. 3). The culms of the tetraploid are distinctly thicker than those of the original diploid.

The leaves of the tetraploid are obviously thick and coarse. The blade of the uppermost leaf is slightly wider for the tetraploid, though the length is not markedly different in the two types.

The number of spikelets per panicle for the tetraploid is reduced to about 60% of that for the comparable diploid. The density of ear, that is the number of spikelets in unit length of panicle, diminishes, therefore, markedly for the tetraploid. The tetraploid spikelet shows a remarkable tendency to develop an awn, and attaches more strongly to the rachilla.

The hulled or unhulled grains of the tetraploid are much larger, the shape or the ratio of the length and width being kept nearly as constant

TABLE I. Measurements on the diploid and tetraploid rice plants (A).

The lines of the materials	The height of the plant (cm)		The length of the ear (cm)		The number of ears per plant		The diameter of the culm (mm)*		The length of the uppermost leaf-blade (cm)		The width of the uppermost leaf-blade (cm)		The number of spikelets per panicle		The density of the ear**	
	M.	S.D.	M.	S.D.	M.	S.D.	M.	S.D.	M.	S.D.	M.	S.D.	M.	S.D.	M.	S.D.
Tetraploid I (T <sub>e</sub> , 2-9)	86.23 ± 12.05		22.84 ± 3.48		8.22 ± 3.02		3.40 ± 0.42		29.68 ± 6.81		1.68 ± 0.23		62.58 ± 15.22		3.35 ± 0.80	
Tetraploid II (T <sub>e</sub> , 12-29)	84.68 ± 11.94		20.77 ± 2.34		7.98 ± 2.96		3.42 ± 0.42		25.07 ± 5.23		1.37 ± 0.14		52.75 ± 14.07		2.99 ± 0.65	
Tetraploid III (T <sub>e</sub> , 30-35)	84.32 ± 16.41		22.64 ± 2.93		6.36 ± 1.43		3.99 ± 0.38		26.27 ± 4.11		1.63 ± 0.10		62.50 ± 15.09		3.21 ± 0.51	
Proto-diploid type of Tetraploid III (S <sub>1</sub> , 84)	105.10 ± 4.15		20.92 ± 1.05		11.84 ± 2.82		3.24 ± 0.23		27.32 ± 3.67		1.44 ± 0.08		96.67 ± 10.05		5.16 ± 0.64	
Tetraploid IV (T <sub>e</sub> , 33-55)	81.83 ± 13.10		20.43 ± 2.67		8.43 ± 3.51		3.56 ± 0.51		24.33 ± 6.45		1.52 ± 0.17		58.18 ± 13.73		3.17 ± 0.61	
Proto-diploid type of Tetraploid IV (S <sub>1</sub> , 88)	104.30 ± 4.21		19.64 ± 1.09		12.34 ± 3.20		3.05 ± 0.21		27.36 ± 3.55		1.44 ± 0.08		92.22 ± 9.23		5.03 ± 0.57	
Tetraploid V (S <sub>1</sub> , 106)	75.21 ± 14.86		20.83 ± 2.64		5.50 ± 2.64		3.48 ± 0.55		27.93 ± 5.46		1.56 ± 0.16		52.95 ± 14.53		3.10 ± 0.53	
Proto-diploid type of Tetraploid V (S <sub>1</sub> , 107)	105.60 ± 4.46		19.40 ± 1.21		12.38 ± 3.21		2.98 ± 0.35		25.24 ± 3.09		1.47 ± 0.07		95.34 ± 9.51		5.09 ± 0.67	
Tetraploid VI (T <sub>e</sub> , 57-58)	67.50 ± 14.14		21.00 ± 1.79		11.40 ± 5.04		3.94 ± 0.34		22.20 ± 3.49		1.36 ± 0.10		52.50 ± 10.49		2.78 ± 0.50	

\* Measured just below the second node from the ear. \*\* Number of spikelets ÷ length of ear.

TABLE II. Measurements on the diploid and tetraploid rice plants (B).

The lines of the materials	The length of the grains (mm)		The width of the grains (mm)		The thickness of the grains (mm)		The weight of the grains (mg)		The shape of the hulled grains (length ÷ width)	
	unhulled	hulled	unhulled	hulled	unhulled	hulled	unhulled	hulled	unhulled	hulled
Tetraploid IV (T <sub>e</sub> , 40)	9.24 ± 0.26	6.43 ± 0.31	3.80 ± 0.13	3.23 ± 0.11	2.59 ± 0.10	2.32 ± 0.10	41.70 ± 2.96	33.70 ± 2.63	1.98 ± 0.11	
Proto-diploid type of Tetraploid IV (S <sub>1</sub> , 88)	7.98 ± 0.16	5.78 ± 0.15	3.54 ± 0.13	3.03 ± 0.10	2.23 ± 0.08	2.06 ± 0.07	31.10 ± 1.84	25.00 ± 1.84	1.90 ± 0.06	
Tetraploid V (S <sub>1</sub> , 106)	9.19 ± 0.16	6.21 ± 0.16	3.89 ± 0.15	3.25 ± 0.10	2.63 ± 0.13	2.29 ± 0.12	40.20 ± 2.48	32.60 ± 2.50	1.91 ± 0.08	
Proto-diploid type of Tetraploid V (S <sub>1</sub> , 107)	7.86 ± 0.16	5.73 ± 0.16	3.56 ± 0.13	3.04 ± 0.09	2.35 ± 0.05	2.09 ± 0.06	31.10 ± 1.73	26.50 ± 1.66	1.88 ± 0.08	



as the diploid. The average weight of the hulled grain of 2 diploid samples was 26.3 mg.; the average for the 2 comparable tetraploid samples being 33.2 mg., or approximately 26 per cent more. Fig. 4 shows the grains of Tetraploid V in comparison with those of its proto-diploid type.

In Table I, it is noticed that the individual variation is generally much larger in the tetraploid lines than in diploid, especially so for the height of the plant and the length of the ear. This may also be taken as a general characteristic of the tetraploid line.



Fig. 4. Comparison of diploid and tetraploid grains; hulled and unhulled grains of Tetraploid V (upper two rows), hulled and unhulled grains of original diploid of Tetraploid V (lower two rows)  $\times 1.5$

### Sterility of the tetraploid

As it is the case with various other parts, the anthers of the tetraploid are obviously larger than those of the normal diploid. Such gigantism is also noticed clearly in the pollen-grains, though nearly their 50% are empty and abnormal in shape. The degree of seed sterility differed considerably in tetraploids of different origin; the percentage of sterility being more than 94 for the highest line and 62 for the lowest. Whether or not the sterility decreases during the course of cultivation is a future



TABLE III  
The size and the percentage of perfect pollen-grains.

	The length of the anther (mm)	The diameter of the pollen-grains ( $\mu$ )	% of the perfect pollen-grains	(Total number of pollen-grains examined)
Tetraploid III ( $S_4$ . 3, 6)	$2.30 \pm 0.17$	$47.38 \pm 4.20$	42.33	(1101)
Proto-diploid type of Tetraploid III ( $S_2$ . 84-10, 59)	$1.98 \pm 0.14$	$43.50 \pm 1.70$	92.75	(1462)
Tetraploid IV ( $S$ . 139-10, 22, 23)	$2.51 \pm 0.20$	$51.18 \pm 6.31$	58.57	(1726)
Proto-diploid type of Tetraploid IV ( $S_2$ . 88-23)	$1.88 \pm 0.16$	$41.90 \pm 2.62$	89.13	( 598)

TABLE IV  
The sterility, parthenocarp and the seed germination.

	Sterility %	Parthenocarp %	Correlation between sterility and parthenocarp	Germination on seed bed %
Tetraploid I. $T_e$ . 1 $T_e$ . 2-9	$62.02 \pm 10.10$ $68.38 \pm 13.72$	$7.18 \pm 3.12$ $7.10 \pm 3.75$	$0.054 \pm 0.149$ $-0.009 \pm 0.128$	$\{T_e$ . 2-9 $\{44.72 \pm 18.87$
Tetraploid II. $T_e$ . 15 $T_e$ . 16 $T_e$ . 21 $T_e$ . 25 $T_e$ . 27 $T_e$ . 12-29 (except 15, 16, 21, 25, 27)	$66.82 \pm 14.58$ $71.00 \pm 15.40$ $72.24 \pm 13.42$ $69.70 \pm 14.57$ $73.14 \pm 12.85$ $71.95 \pm 14.95$	$13.16 \pm 5.84$ $13.30 \pm 6.01$ $12.14 \pm 4.33$ $16.28 \pm 7.44$ $18.19 \pm 9.21$ $14.48 \pm 6.73$	$0.261 \pm 0.037$ $0.462 \pm 0.137$ $0.277 \pm 0.152$ $0.468 \pm 0.094$ $0.600 \pm 0.099$ $0.255 \pm 0.059$	$\{T_e$ . 12-69 $\{64.17 \pm 9.72$
Tetraploid III. $T_e$ . 30-35	$94.78 \pm 6.00$	$30.33 \pm 10.29$	$-0.132 \pm 0.328$	$\{T_e$ . 30-35 $\{72.50 \pm 26.54$
Proto-diploid type of Tetraploid III ( $S_2$ . 84)	$7.20 \pm 3.40$	$1.80 \pm 1.83$	$0.795 \pm 0.116$	
Tetraploid IV. $T_e$ . 36-55	$86.22 \pm 11.31$	$27.64 \pm 12.29$	$0.336 \pm 0.115$	$\{T_e$ . 36-55 $\{66.07 \pm 25.87$
Proto-diploid type of Tetraploid IV ( $S_2$ . 88)	$7.00 \pm 2.53$	$2.40 \pm 1.56$	$0.304 \pm 0.025$	
Tetraploid V. $T_e$ . 56 $S_1$ . 106	$85.73 \pm$ $88.82 \pm 9.50$	$25.37 \pm$ $36.91 \pm 10.15$	$-0.025 \pm 0.213$	$\{T_e$ . 56 $\{50.00 \pm$
Proto-diploid type of Tetraploid V. ( $S_1$ . 107)	$6.13 \pm 2.94$	$3.09 \pm 2.98$	$0.108 \pm 0.206$	
Tetraploid VI. $T_e$ . 57-58	$89.66 \pm$	$22.98 \pm$		$\{T_e$ . 57-58 $\{60.00 \pm$

problem of interest. The fact that Tetraploid II, which has been under cultivation for nearly 15 years, still shows about 70% sterility indicates that such decrement, if any, must occur very slowly under normal cultivation. The correlation coefficient between sterility and parthenocarpy is extremely variable, and it is so even among the lines having the same origin. A fairly high percentage of tetraploid seeds failed to germinate on the ordinary seed bed (Table III and IV).

## Cytological observations

### MATERIALS AND METHODS

To ascertain the tetraploid nature of the plant by the microscopical examination, root-tips fixed with FLEMMING's solution were sectioned by the paraffin method, and stained with iron-alum-haematoxylin. Micro- and megasporogenesis were studied exclusively on the materials taken from Tetraploid I. The young spikelets were fixed with BOUIN's solution, and the later treatments were essentially the same as those for the root-tips.

### OBSERVATIONS ON THE SOMATIC CHROMOSOMES

As already mentioned, the somatic number of chromosomes was ascertained for all tetraploid lines obtained. The tetraploid plant produced tetraploid offspring with some exceptional aneuploid plants. Figs. 5 a and b show 48 somatic chromosomes observed respectively in Tetraploid I and III.

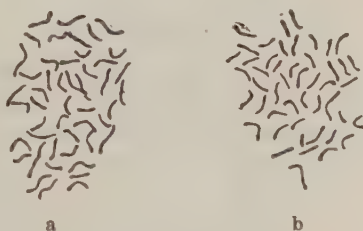


Fig. 5, a-b. Forty eight somatic chromosomes in the root-tip cells of tetraploid *Oryza sativa*; 5a. Tetraploid I; 5b. Tetraploid III.  $\times 2670$

### MICROSPOROGENESIS

*Heterotypic prophase*: The behaviour of chromosomes in the microsporocyte was followed chiefly in the diakinesis. The nucleus in this stage contained a variable number of chromosomes ranging, so far as the authors could observe, between 13 and 20. The nucleus represented in Fig. 6 contains 15 chromosomes, of which 6 small ones, simple in shape, are assumed to be bivalents, while others are regarded as tetravalents. The chromosomes in diakinesis were assumed to be either tetravalent or bivalent, but clear discrimination of the valencies could hardly be made

for some chromosomes. The shapes of some tetravalents in this stage are illustrated in Fig. 7. Two tetravalents were rarely situated in contact, but it was impossible to decide whether or not there was any connection as an octovalent. The authors counted the number of chromosomes in

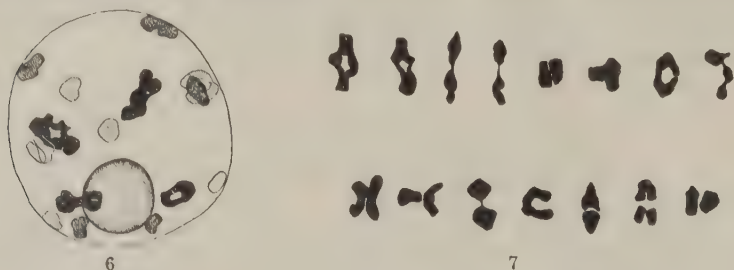


Fig. 6. Diakinetic nucleus of tetraploid *Oryza sativa*; 9 tetravalents +6 bivalents.  $\times 2670$ .

Fig. 7. Appearances of tetravalents in diakinesis.  $\times 2670$ .

53 diakinetic nuclei, and the average number of chromosomes calculated for a nucleus was 16.04. Chiefly on the basis of this calculation, the average number of tetravalents in a diakinetic nucleus was assumed to be 7.96 (Table V). One large nucleolus was usually observed in this stage.

TABLE V  
Frequency of the tetravalents observed in the heterotypic division.

Total number of chromosomes		12	13	14	15	16	17	18	19	20	21	Number of cells examined	Average number of tetravalents
Number of tetravalents		12	11	10	9	8	7	6	5	4	3		
Microsporo-genesis	Diakinesis	0	4	7	10	10	11	7	3	1	0	53	7.96
	I—M*	4	9	7	17	6	2	3	0	0	0	48	9.38
Megasporo-genesis	Diakinesis	0	1	1	2	1	0	0	0	1	0	6	8.50
	I—M	1	0	1	3	1	1	0	0	0	0	7	9.14
Total		5	14	16	32	18	14	10	3	2	0	114	8.66

\* Very rare exceptional octovalent was calculated as 2 tetravalents and 2 univalents as a bivalent.

*Heterotypic metaphase:* In the heterotypic metaphase, the chromosomes which were usually tetravalent or bivalent, arranged themselves on the equatorial plate with a slight tendency for bivalents to come into the outer position. In the majority of cases, the tetravalents in their polar view assumed cocoon-like shape of various compactness, while in others

the components of the tetravalent were assorted in more irregular and complicated forms. Thus the valency of chromosomes in this stage was more easily to be discriminated from their shape and size. The plate depicted in Fig. 8 contains 12 tetravalents exclusively, while the plate shown in Fig. 9 possesses 11 tetravalents and 2 bivalents. The authors studied 48 metaphasic plates perpendicular to the optical axis, and the maximum and minimum numbers of tetravalents observed were respectively 12 and 6, the average number of tetravalents being 9.38 (Table V).



Figs. 8-12. Polar views of the heterotypic metaphase of tetraploid *Oryza sativa*; 8. with 12 tetravalents; 9. with 11 tetravalents+2 bivalents; 10. with 6 tetravalents+11 bivalents+2 univalents; 11. with 1 octovalent+7 tetravalents+6 bivalents.  $\times 2670$  Fig. 12. Side views of chromosomes in early heterotypic anaphase; 9 tetravalents+6 bivalents.  $\times 2670$

The complement depicted in Fig. 10 represents an exceptionally complicated case having 6 tetravalents, 11 bivalents—one of which has disjoined already—and 2 univalents. No other case of true univalents, however, was met with in these studies. The authors observed two cases of octovalent formation, and two cases of early disjunction of one component of a tetravalent. Fig. 11 contains 7 tetravalents, 1 octovalent and 6 bivalents.

*Heterotypic anaphase:* In the heterotypic anaphase, the chromosomes disjoined into 4 homologues, which, as a rule, were evenly distributed to each pole. Fig. 12 shows early anaphasic chromosomes in their side views. Fig. 13 is the polar view of a plate in which 12 tetravalents have nearly disjoined making 12 groups of 4 homologues in various configurations. The chromosomes of a later anaphasic stage making two sister plates, upper and lower, are depicted in Fig. 14. Each plate contains 24 chromosomes, and two homologues going to the same pole are now fully separated

revealing the split for the next division. Though 1 or 2 lagging chromosomes were sometimes met with, the division process, as a whole, was very regular, and the cytokinesis which followed was also normal.



Figs. 13 and 14. Polar views of the heterotypic anaphase of tetraploid *Oryza sativa*; 13. early anaphase showing 12 groups of 4 homologues; 14. late anaphase, two plates upper (a) and lower (b) contain respectively 24 chromosomes.  $\times 4000$

*Homotypic division:* The chromosomes on the homotypic plate did not disperse so well as they did in the heterotypic metaphase. Figs. 15, 16 and 17 illustrate the common and normal appearance of the homotypic metaphase. Though sometimes 1 or 2 lagging chromosomes were also observable in the anaphase, the division went through normally otherwise, and the cytokinesis was also carried out in the ordinary manner.



Figs. 15-17. Polar views of the homotypic metaphase showing 24 chromosomes.  $\times 4000$

### MEGASPOROGENESIS

The megasporogenesis was studied in nearly all tetraploid ovaries. Degeneration of the embryo-sac mother-cell before the meiotic division was observed only in one ovary out of 149 ovaries observed (Fig. 18). In the majority of cases, the maturation division started ahead in the pollen mother-cell. In 38 flowers out of 57, the embryo-sac mother-cell started the division nearly at the same time as the tetrad stage of the microsporogenesis. The mega- and microsporogenesis occurred simultaneously in 6 flowers, while the megasporogenesis forestalled the other only in the remaining 13 flowers (Table VI).



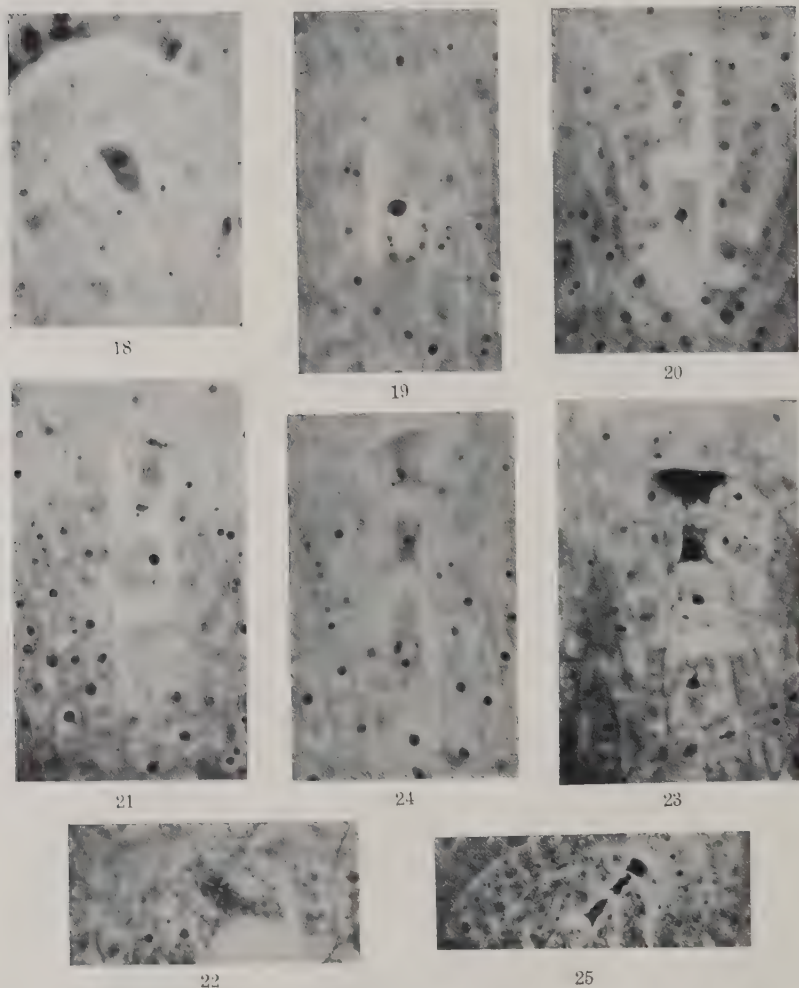
*Heterotypic division*: Generally the nucleus in the heterotypic prophase contained one large nucleolus often accompanied by a small accessory one. Two nucleoli of similar size, however, were observed in 7 out of 72 nuclei studied. Though the number of heterotypic nuclei studied was relatively small, the results of observations given in the following account will suffice to show that the behaviours of chromosomes were essentially the same in both kinds of sporocyte. Figs. 19 and 26, representing the same nucleus, are shown to illustrate the general aspect of

TABLE VI  
Relative stages of meiotic divisions in EMC and PMC.

		PMC in						
		late pro- phase	Diaki- nesis	first division	inter- phase	second division	tetrad stage	micro- spores
EMC in	Diakinesis	1	1		2	1	2	1
	first division	1		3	2	1	8	2
	interphase			2			1	3
	second division		2	5		2	6	11

diakinetic nucleus, and the respective chromosomes, 8 tetravalents and 8 bivalents, contained inside. Two other diakinetic nuclei including respectively 9 tetravalents and 6 bivalents, and 10 tetravalents and 4 bivalents are depicted in Figs. 27 and 28. A slightly earlier diakinetic nucleus shown in Fig. 29 contains 4 tetravalents and 16 bivalents, the minimum number of tetravalents thus far observed. Two metaphasic plates having respectively 15 and 14 chromosomes are also represented in Figs. 30 and 31. As shown in Fig. 30a, the spindle fiber bundles for the tetravalents appear in well stained preparations, more conspicuously than those for the bivalents. The authors could ascertain the valency of each chromosome for 13 heterotypic nuclei with the results summarized in Table V. The maximum number of tetravalent was 12, and the minimum number was 4, the average number being 8.85. The division process proceeded normally, resulting in 2 secondary sporocytes, one on the micropylar and the other on the chalazal position (Fig. 20).

*Homotypic division*: The homotypic division processes did not proceed simultaneously in the two sister sporocytes, the chalazal one usually forestalling the other (Fig. 21). The authors had very little opportunity of finding clear metaphasic plates, and the chromosomes, 22-24 in number, were fairly distinguishable in only 3 metaphasic plates. Two megaspores and one secondary sporocyte, the micropylar one, having 24



Figs. 18-25. Photographs of ovules in tetraploid *Oryza sativa*; 18. degenerating EMC. ( $\times 680$ ); 19. EMC in diakinesis, the same cell which is depicted in Fig. 26. ( $\times 680$ ); 20. two secondary sporocytes, the micropylar one in the upper position. ( $\times 680$ ); 21. divisions of secondary sporocytes, the micropylar sporocyte in telophase, the division has been completed in the chalazal one. ( $\times 680$ ); 22. division of secondary sporocyte, the micropylar sporocyte in anaphase. ( $\times 910$ ); 23-25. degeneration of megaspores leaving the one in the innermost position. (Figs. 23 and 24.  $\times 680$ ; Fig. 25.  $\times 340$ )

late metaphasic chromosomes, are represented in Fig. 32. Side views of an anaphasic plate given in Figs. 22 and 33 will serve to show the regularity of the division. The axis of the homotypic division was, as a rule, parallel to that of the heterotypic division in the chalazal sporocyte,

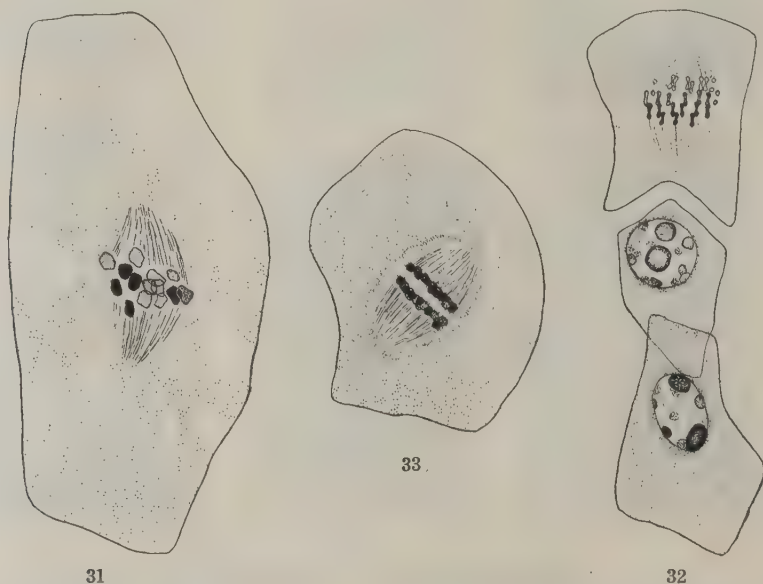


Figs. 26-30. Megaloporogenesis in tetraploid *Oryza sativa*; 26. EMC with a diakinet nucleus containing 8 tetravalents + 8 bivalents, the same cell is also presented in Fig. 19. ( $\times 2160$ ); 27-29. diakinet nuclei containing respectively 9 tetravalents + 6 bivalents, 10 tetravalents + 4 bivalents, and 4 tetravalents + 16 bivalents. ( $\times 2160$ ); 30a. side view of an EMC in heterotypic metaphase. ( $\times 2160$ ); 30b. 9 tetravalents + 6 bivalents contained in Fig. 30a. ( $\times 2880$ )

but the axis developed in random direction in the micropylar one (Fig. 21). Three megaspores out of the 4 thus produced degenerated soon, leaving the innermost one which was destined to organize the embryo-sac (Figs. 23, 24 and 25). In some cases, such a degeneration process sets in quite early in the later homotypic stage of the micropylar sporocyte.

## EMBRYO-SAC FORMATION

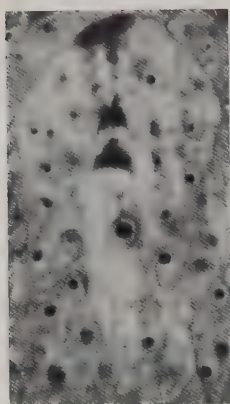
In nearly half the number of ovaries, the innermost megaspore started a long growth process, producing conspicuous vacuoles in the cytoplasm (Figs. 34, 35 and 36). Out of 149 ovaries examined, the authors observed the first step of sac formation in 87 ovaries, and in 60 ovaries the spores degenerated soon after the second cytokinesis, while in 2 ovaries the degeneration process sets in still earlier before or during the course of the meiotic division. The ovaries with no growing megaspore



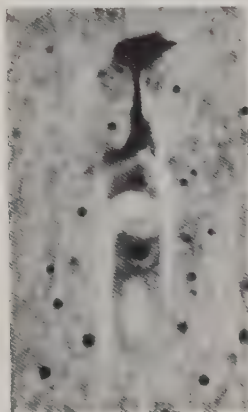
Figs. 31-33. Megasporogenesis in tetraploid *Oryza sativa*; 31. EMC containing 14 heterotypic chromosomes. ( $\times 2160$ ); 32. a secondary sporocyte with 24 late metaphasic chromosomes and 2 megaspores. ( $\times 2160$ ); 33. a secondary sporocyte showing the regularity of nuclear division. ( $\times 2160$ )

usually grew up at normal rate by the time of blooming, then decreasing the rate they attained to various final stages of development (Fig. 37). The nucleus of the megaspore developing into an embryo-sac divides three times successively in the normal manner. Fig. 42 shows the first post-meiotic division, and two nucleated sacs in different stage of development are represented in Figs. 43 and 38. Fig. 44 shows an embryo-sac with 4 nuclei which will divide before long for the third time. The 8 nuclei produced in this way differentiated respectively into the typical sac ap-

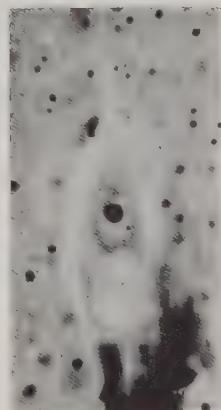
paratases. A very young embryo-sac containing 2 synergid-cells, 1 egg-cell, 2 pole-nuclei, and 8 antipodal cells each containing one nucleolus is depicted in Fig. 45. The egg-cell in this stage was hardly distinguishable



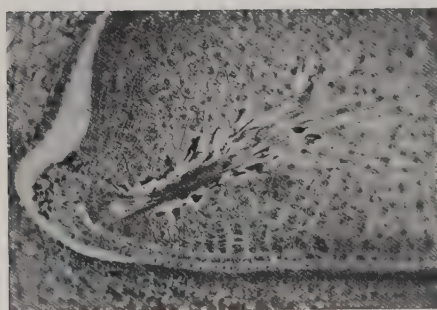
34



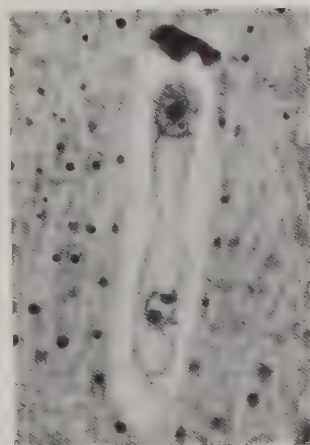
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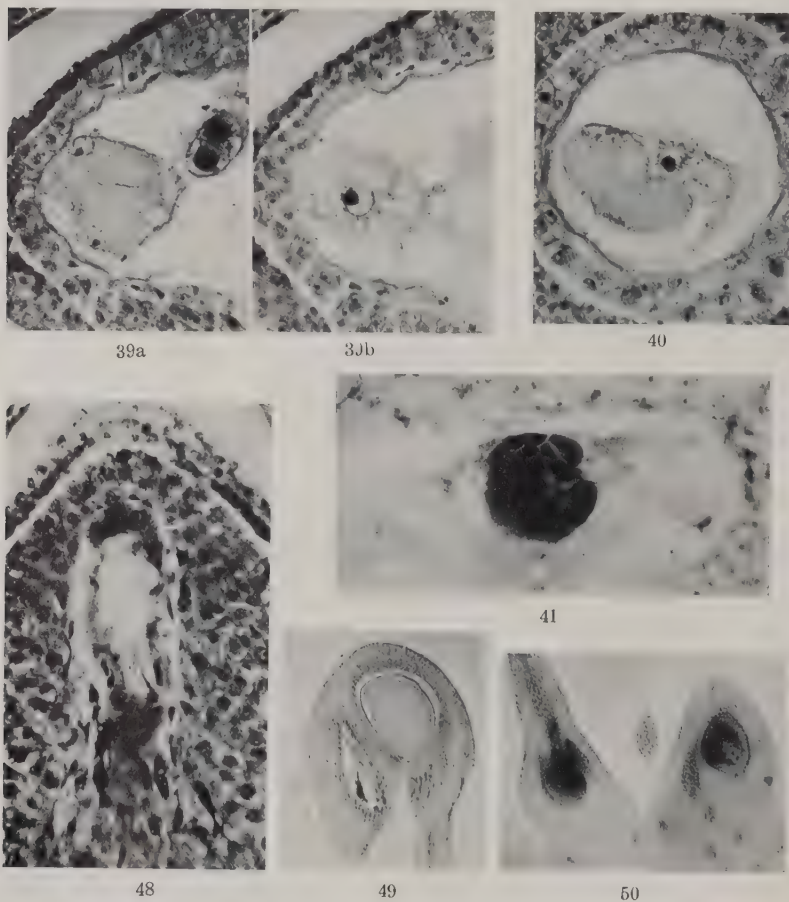
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Figs. 34-38. Photographs of ovules in tetraploid *Oryza sativa*; 34-36. growth of the innermost megaspores. ( $\times 680$ ); 37. growth of ovary without megaspore developing. ( $\times 155$ ); 38. a young embryo-sac in two nucleated stage. ( $\times 680$ )

from the synergid. In full-grown embryo-sac, such as is shown in Fig. 46, however, the egg-cell was to be identified very easily for its vacuolized protoplasm and large nucleolus with much chromatic substance (Figs. 39



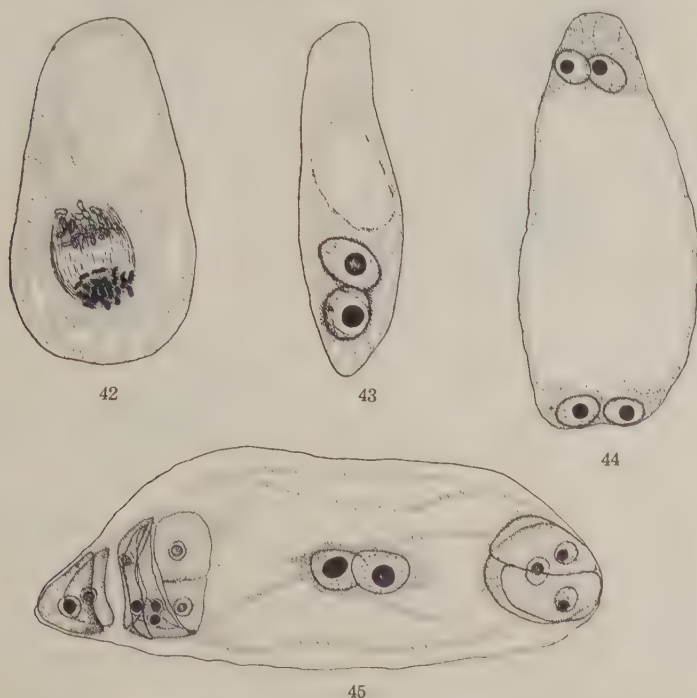
and 40). The differentiation of the pole nuclei seemed to be accomplished in a rather early stage of sac maturation. The primary antipodal cells



Figs. 39-41 and 48-50. Photographs of the embryo-sacs and ovaries of tetraploid *Oryza sativa*; 39 a and b. two consecutive longitudinal sections of the micropylar part of an embryo-sac, a. contains two synergids and two pole nuclei, b. contains the egg-cell. ( $\times 340$ ); 40. a cross section of embryo-sac containing parts of synergids and egg. ( $\times 340$ ); 41. a mass of antipodal cel's. ( $\times 310$ ); 48. an abnormal embryo-sac containing a large number of small bare nuclei. ( $\times 340$ ); 49. an ovary with two ovules. ( $\times 40$ ); 50. a flower with two ovaries. ( $\times 40$ )

divided continuously, and even such a young sac with undifferentiated egg, contained 5-17 antipodal cells. In matured sacs, the number of the

cells amounted to 20–80, and cell division was observed among them even after fertilization (Fig. 41 and Table VII). The embryo-sac depicted in Fig. 46 contains 61 antipodal cells.



Figs. 42-45. Embryo-sac formation in tetraploid *Oryza sativa*; 42. the first division of the megaspore nucleus. ( $\times 2160$ ); 43. a young embryo-sac in 2 nucleated stage. ( $\times 1080$ ); 44. a young embryo-sac in 4 nucleated stage. ( $\times 720$ ); 45. a young embryo-sac with 2 synergid-cells, 1 egg-cell, 2 pole-nuclei, and 8 antipodal cells. ( $\times 720$ )

*Abnormal embryo-sacs:* The authors examined in total 163 embryo-sacs, of which 152 sacs contained normal sac apparatuses such as have been described already. Various abnormalities shown by the remaining 11 sacs are as follows: a) Three sacs contained 1 extra pole nucleus in addition to the normal ones, other sac apparatuses being normal. b) One sac possessed normal synergids and the egg-cell, but malformed antipodal cells, the pole nucleus being entirely lacking. c) One embryo-sac was composed of 2 secondary sacs, each containing a large number of cells or bare nuclei (Fig. 47). d) A few sacs contained abnormal, large antipodal

cells having supernumerary nuclei, other apparatuses being normal. e) The locule cavity of two sacs were filled up with a large number of small bare

nuclei, leaving a hollow only in the center of the locule (Fig. 48). f) One embryo-sac contained 2 pole nuclei and a group of antipodal cells as usual, but the synergids and the egg-cell were replaced by a large cell containing a large number of small nuclei.



Fig. 46. A fully matured embryo-sac with 61 antipodal cells. ( $\times 360$ )

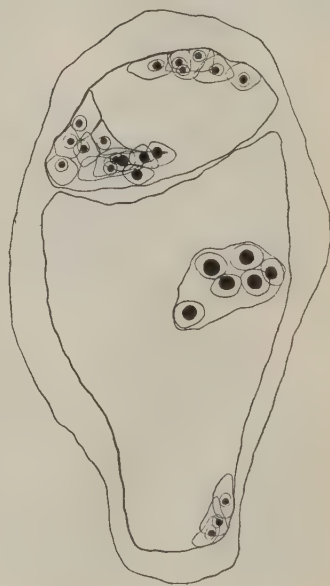


Fig. 47. An abnormal embryo-sac composed of 2 secondary sacs each containing a large number of cells or bare nuclei. ( $\times 360$ )

In the course of these studies the authors found also one ovary with two ovules of normal appearance, and a flower with two normal ovaries (Figs. 49 and 50).

TABLE VII  
Number of antipodal cells contained in an embryo-sac.

	Number of antipodal cells	Frequency
Sac in early stages of its maturation	5-7	4
	8-10	4
	11-13	5
	14-16	5
	17	2
Matured sac	19-23	10
	24-28	5
	29-33	10
	34-38	5
	39-43	9
	44-48	5
	49-53	3
	54-58	3
	59-63	4
	64-68	2
	69-73	2
	74-78	1
Sac after fertilization	27	1
	53	1
	61	1
	93	1

### Consideration

The writers have reported in the first and the second papers of this series on the spontaneous haploid and triploid plants of *Oryza sativa* L., and have now described the spontaneous autotetraploid plants of the same species (4, 5). Though there are no direct studies to prove how the autotetraploids here reported have been generated, the following two facts may be worthy of note in this connection: a) Excepting Tetraploid II of unknown origin, all of the tetraploid lines (Tetraploid I and Tetraploid III-VI) were produced by highly sterile individuals. b) In all of the cases of known origin, except the case of Tetraploid I, several or a number of tetraploid individuals appeared at once among the diploid offspring of a diploid plant, no triploid individuals being mixed with them. The first fact might be taken to indicate some causal connection of the generation of the tetraploid and a certain type of sterility, while the next fact makes it hardly conceivable that the tetraploids were produced by the union of two unreduced gametes caused by an occasional abnormal reduction divisions. Thus the following two ways, the production of  $4n$  somatic sections in mosaic, or the production of  $4n$  proembryos are left as the more probable direct processes causing the present tetraploids. The authors observed many cases of diploid seed formation on the diploid

somatic sections of the haploid rice plant (4). If a similar phenomenon will take place also in certain sterile diploid plants, a number of tetraploid seeds or tetraploid plants will be produced at once, though, contrary to the present cases, such mosaic plants should be detected fairly easily by their appearances. On the other hand it has been reported that the root-tips of rice seedlings treated with certain high temperatures (42–45.5°C) contain many tetraploid cells in mosaic, and that *Zea mays* L., of which seedlings also respond to high temperatures in the like manner, produces tetraploid seedlings in considerable frequency if treated for short periods with 38–40°C in the early embryonic stage (3, 9). Induction of the tetraploid plants by the high temperature treatment (43°C) during the first cell division in the proembryo was also accomplished by E. DORSEY in the case *Triticum* as well as of *Secale* (1). As the rice plant in the stage of anthesis may be not infrequently subjected to temperatures as high as those which produces chromosomal doubling in their somatic cells, it might be assumed that the tetraploids here reported, or at least some of them, may also have been generated by the same process as the artificially induced tetraploids of *Zea* and *Triticum*. Recently S. NAMIKAWA and J. KAWAKAMI (8) have reported an entirely different type of the tetraploid (as well as haploid and triploid) generation as a member of twins. So far as the authors have been able to estimate by a large scale germination test, however, the frequency of twin formations is very low in rice, and neither haploid nor any kind of polyploid were found as a member of twins. Thus the chance of polyploid or haploid formation by such a process seems to be very limited in rice, though not entirely excluded.

The autotetraploid mutants with twice as many chromosomes as the normal diploid, exhibit giant characteristics as do the autotriploid mutants, but the former type is differentiated rather easily from the latter by its characteristic stumpyness and short panicle stalks. Some awnless varieties develop awns in triploid or tetraploid constitution, the facts showing clearly that the awn development depends not only on the quality of the gene constitution, but also on the doses of such complement.

The fertility of the haploid rice plant was practically negligible, and that of the triploid was about 2%, while the fertility of the tetraploid, thus far treated, ranged between 5–35%, the average percentage being about 20. The tetraploid plant reported by E. NAKAMORI showed 27% fertility. It may be worthy of note here that the fertility of the haploid, triploid and tetraploid mutants of *Triticum vulgare* found by S. NAMIKAWA and J. KAWAKAMI were much higher in contrast to the fertility of the rice mutants, the actual percentages for *Triticum* mutants being respectively 2, 10 and 80.5.



The chromosome behaviours during the reduction divisions are essentially the same in micro- and megasporogenesis. Each four homologous chromosomes contained in the tetraploid plant usually conjugate in the heterotypic division either as a tetravalent or two bivalents. The number of tetravalents in a sporocyte ranged, so far as the authors observed, between 12 and 4, and the average number calculated was 8.66. Thus the tendency of making tetravalents seems to be much stronger than that suggested by K. ICHIJIMA (2). The occurrence of an octovalent, though very rare, also attracts the notice. In the heterotypic anaphase, the tetravalent disjoins into 4 homologues, and even distribution of them to each pole is accomplished quite regularly. In the homotypic metaphase, some chromosomes are situated closely giving the appearance of so-called secondary association, but no such a tendency of four chromosomes making a group was noticed. Though the majority of spores thus formed no doubt contain 24 chromosomes, a half of the microspores more or less failed to develop into normal pollen-grains, and about 40% of the innermost megaspores, which were destined to form the embryo-sac, degenerated soon after the second cytokinesis.

The embryo-sac formation is carried out with comparatively few exceptions in the usual manner, producing a large mass of antipodal cells. The fertility of the tetraploid plant, however, is far less in comparison with the percentage of the well formed embryo-sac. The percentage of the germinable seeds is rather low, but the type is easily maintained by seed propagation.

### Summary

1. The authors discovered in 1933 one autotetraploid plant of *Oryza sativa* L. in the  $F_4$  progeny of a sterile intraspecific hybrid. Since that they have found many autotetraploid plants in the offspring of 3 highly sterile plants, and one plant with highly sterile portion or tillers. One highly sterile variety cultivated since 1922 is also ascertained to have been of tetraploid nature.

2. The tetraploid plant shows typical *gigas* type, and it is to be discriminated from the triploid by its characteristic stumpyness and short panicle stalks. Tetraploidy promotes remarkably the development of awns.

3. The fertility of the tetraploid varies considerably in natural conditions according to the lines, the percentage for the lowest being 5, and for the highest 35. The percentage of the parthenocarpic ovaries is also variable in different lines, as also the degree of correlation between sterility and parthenocarpy calculated for the line on the individual plant basis.

4. How the tetraploid plants reported in this paper have been generated is not proved experimentally, but somatic chromosome doubling either in proembryo or in later meristematic tissues may be regarded as the direct process.

5. The chromosome behaviours during the reduction divisions are essentially the same in the micro- and megasporogenesis. The four homologous chromosomes conjugate to a tetravalent or 2 bivalents, and the maximum and the minimum numbers of tetravalents for a sporocyte were respectively 12 and 4, the average number being 8.66. The components of the tetravalent, as a rule, are distributed evenly to the poles, and all the nuclear and cell division processes are carried out regularly.

6. Nearly half of the microspores thus formed are clearly non viable, and in about 40% of the ovaries no megaspores show further development. The mode of embryo-sac formation proceeded normally except in comparatively few cases.

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  6. ———, 1936. Observations on the autotetraploid rice plants (A preliminary note), in Japanese. *Japan. Jour. Genetics* **12**: 59.
  7. NAKAMORI, E., 1933. On the occurrence of the tetraploid plant of rice, *Oryza sativa* L. *Proc. Imp. Acad.* **9**: 340-341.
  8. NAMIKAWA, S. and KAWAKAMI, J., 1934. On the occurrence of the haploid, triploid and tetraploid plants in twin seedlings of common wheat. *Proc. Imp. Acad.* **10**: 668-671.
  9. RANDOLPH, L. F., 1935. Cytogenetics of tetraploid maize. *Jour. Agric. Res.* **50**: 591-602.
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## A revision of the genus *Pseudostellaria*

By Jisaburo OHWI<sup>(1)</sup>

(Received May 31, 1937)

The name *Pseudostellaria* was recently proposed by PAX for *Krascheninnikovia* TURCZ., a small genus of Caryophyllaceae, by the existence of an earlier homonym of GÜLDENSTÄDT. According to the International Rules of Botanical Nomenclature, PAX's name should be accepted unless it is rejected by the Rules. And the change of generic name does not cause any important influences upon the other branches of Science, as none of the species are utilized by us. I prefer, therefore, to adopt *Pseudostellaria* of PAX instead of the TURCZANINOV's older name.

Since TURCZANINOV established the genus based upon his new species, *Krascheninnikovia rupestris*, it has been successively treated by MAXIMOWICZ, FRANCHET, KORSHINSKY, and TAKEDA. The genus now contains thirteen species. They are limited to the Eastern Asia and not extending westwards over the Himalayan and Altai Mountains. Five of them occur in Japan Proper:

1. *P. Palibiniana*,      2. *P. heterophylla*,      3. *P. sylvatica*,
4. *P. heterantha*, and 5. *P. japonica*.

They are all common to the Asiatic Continent.

The following nine species are found in Korea, Manchuria, and the Eastern Siberia inclusive of the Altai Mountains:

1. *P. rupestris*,      2. *P. setulosa*,      3. *P. Okamotoi*,
4. *P. rigida*,      5. *P. Palibiniana*,      6. *P. heterophylla*,
7. *P. Davidi*,      8. *P. japonica*, and      9. *P. sylvatica*.

The first four are confined to these regions.

In China the genus is represented by seven species:

1. *P. heterophylla*,      2. *P. sylvatica*,      3. *P. heterantha*,
4. *P. Davidi*,      5. *P. sessilifolia*,      6. *P. tibetica*, and
7. *P. eritrichioides*.

The last three are endemic there.

*Pseudostellaria* is distinguished from its close relatives, *Stellaria* and *Arenaria*, by the formation of cleistogamic flowers. But the cleistogamy

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is not yet observed in *P. rigida*, *P. sessilifolia* and *P. setulosa*, which is probably due to the scantiness of the materials.

In the greater part of the species, the inflorescence is usually represented by a single terminal flower, and no other cases are hitherto known in *P. Palibiniana*, *P. setulosa*, and *P. Okamotoi*. But in *P. sylvatica* and *P. rupestris*, for example, it is more often composed of few flowers, arranged in a loose typical dichasium. It is commonly much abbreviated and is false-umbellate in *P. heterophylla*. In some other species, i.e. *P. heterantha*, *P. Davidi*, and *P. japonica*, only one leafy bracteate branch, terminated by a flower, shoots out often from the apical or upper node of the stem, ending in a single flower, and thus the lower flower appears to be lateral.

The sepals and petals are, as usual in the other member of Caryophyllaceae, pentamerous in the chasmogamic flowers, but they vary from five to eight in *P. Palibiniana*. The sepals are membranaceous, one- or obscurely three-nerved, and acute or somewhat acuminate at the apex. The petals are bifid or entire at the apex. The number of styles fluctuates even in the same individual and it is, therefore, of no use for the determination of the species, as has already been pointed out by TAKEDA.

The genus can be divided into two groups according to the shape of tubercles of the seed. The seeds of *P. rupestris* are loosely beset with the glochidiate, elongated tubercles, while those of the rest, except *P. sessilifolia*, known only in the flowering stage, are densely clothed with the conical mamillae ending in an erect, deciduous, minute spine.

The present study is based upon the materials preserved in the following herbaria:

1. Herbarium of the Botanical Institute, Kyoto Imperial University (no special sign is given after the citation of specimens).
2. Herbarium of the Botanical Garden and Museum, Berlin-Dahlem (abbreviated as HB in the citation of specimens).
3. Herbarium of the Natural History Museum, Paris (abbreviated as HP).
4. DRAKE Herbarium in the Natural History Museum, Paris (abbreviated as HD).
5. Herbarium of the Academy of Science, Leningrad (abbreviated as HL).

Before going further, I wish here to express my best thanks to Dr. G. KOIDZUMI, Professor of the Imperial University, Kyoto, for his general guidance. Thanks are also due to Prof. H. HUMBERT of the Paris Museum, to Prof. R. PILGER of the Botanical Museum, Berlin-Dahlem, and to Prof. V. SAVICZ of the Academy of Science, Leningrad, for their kindness in lending me specimens, and also to Dr. C. G. ALM for his kindness in giving me the material collected by Dr. HARRY SMITH.



## Key to the species

- Ser. 1. *Glochidiatae* OHWI, ser. nov.—Semina tuberculata, tuberculis subcylindricis apice spinulis 3–5 patentibus persistentibus glochidiatis .....1. *P. rupestris*
- Ser. 2. *Mamillatae* OHWI, ser. nov.—Semina tuberculis conicis apice spinula unica decidua terminatis mamillata.
- Subser. 1. *Verticillatae* OHWI, subser. nov.—Foliorum paria 2 superiora plerumque approximata, ita folia subverticillatim disposita, floribus terminalibus.
1. Pedicelli glabri .....2. *P. Palibiniana*
  1. Pedicelli puberuli.
    2. Folia glabra vel margine facieque brevissime pilosula.
      - .....3. *P. setulosa*
    2. Folia glabra vel margine facieque brevissime pilosula.
      3. Folia superiora ovata vel rhomboidea vel raro lanceolata, flores chasmogamici 1–5, cleistogamici pedicello brevi fulti .....4. *P. heterophylla*
      3. Folia superiora rhombeolanceolata, flores chasmogamici 1, cleistogamici pedicello elongato fulti .....5. *P. Okamotoi*
- Subser. 2. *Distantes* OHWI, subser. nov.—Foliorum paria superiora plerumque inter se distantia, flores chasmogamici terminales et laterales.
1. Caules e basi ascendente sursum erecti non reclinati, calyx basi glabrescens vel parce pubescens.
    2. Folia margine praeter basin glabra.
      3. Caules erecti, folia homomorpha linearia vel linearilanceolata, flores terminales solitarii vel dichasium pauciflorum laxum formantes.
        4. Rhizoma abbreviatum, radices tuberiferi, folia tenuia membranacea, pedicelli longiusculi .....6. *P. sylvatica*
        4. Rhizoma elongatum ascendens, radices tenui-cylindracei fasciculati, folia rigida coriacea crassiuscula, pedicelli breves .....7. *P. rigida*
      3. Folia superiora late lanceolata usque ovata, flores 1–3 terminales et laterales.
        4. Caules flaccidi saepe basi ascendentes, folia tenuiter membranacea, inferiora spathulata, superiora ovata vel oblongo-ovata ...8. *P. heterantha*
        4. Caules vix flaccidi, folia crassiuscula, inferiora minuta, superiora ovata .....9. *P. sessilifolia*
    2. Folia superiora ovata vel late ovata, margine ex toto ciliata.
      3. Folia superiora basi rotundata subsessilia, margine subtusque ad costas longiuscule pilosa, flores cleistogamici distincte pedicellati ...10. *P. japonica*
      3. Folia superiora basi abrupte acuta petiolata, margine breviter ciliata, flores cleistogamici subsessiles .....11. *P. tibetica*
  1. Caules demum valde elongati reclinati, calyx basi densiuscule pubescens.
    2. Folia superiora glabra vel margine inferne tantum longiuscule ciliata ..12. *P. Davidi*
    2. Folia superiora margine ex toto ciliata, facie interdum longiuscule pilosa. ....13. *P. eritrichioides*



## Enumeration of the species

1. *Pseudostellaria rupestris* (TURCZ.) PAX ex PAX et HOFFM. in ENGL. Pfl.-fam. ed. 2, 16c (1934) 318.

*Krascheninnikovia rupestris* TURCZ. Flor. Baic. Dahur. 1 (1842) 238; FENZL in LEDEB. Flor. Ross. 1 (1842) 373; REGEL Plant. Raddean. 1 (1862) 379, t. 9, f. 7-11; MAXIM. in Mém. Biol. 9 (1873) 37, excl. pl. ex japon.; KORSH. in Bull. Acad. Imper. Sci. St. Pétersb. 9 (1898) 40; KOMAR. in Act. Hort. Petrop. 22 (1903) 179; TAKEDA in Kew Bull. (1913) 88; MURAVJ. in KOMAR. Flor. URSS. 6 (1936) 426, t. 22, f. 6.

*Stellaria rupestris* (non SCOP.) HEMSL. in Journ. Linn. Soc. 23 (1886) 69 excl. pl.; FRANCH. Pl. Delavayan. (1890) 101.

*Krascheninnikovia Borodini* KRYL. in Mém. Bot. off. M. Borod. (1927) 220.

Siberia orientalis: Amuria in Burejae montibus (TURCZANINOV in HB ex pte et in HP), Dahuria in rupestr. ad Urgudei (FISCHER in HP), ad fl. Ona (FISCHER in HP), In rupibus ad Bystram (TURCZANINOV in HL).

The seed was first described as having diglochidiate tubercles, but in reality, it has three to five persistent minute patent spines at the apex of tubercles. A part of the specimen at Berlin-Dahlem labelled as *K. rupestris*, and collected by the original author, has the calyx conspicuously pubescent at the base. This is nothing but *P. Davidi* in young stage. *K. Borodini*, of which I have seen no specimen, is conspecific to this plant, according to MURAVJEVA l. c.

2. *Pseudostellaria Palibiniana* (TAKEDA) OHWI in Act. Phytotax. et Geobot. 4 (1935) 32.

*Krascheninnikovia raphanorhiza* PALIB. in Act. Hort. Petrop. 17 (1898) 92, excl. syn.

*Krascheninnikovia Palibiniana* TAKEDA in Kew Bull. (1913) 89.

*Krascheninnikovia Palibiniana* var. *polymera* NAKAI in Bot. Mag. Tokyo 35 (1921) 133.

*Pseudostellaria monantha* OHWI in Journ. Japan. Bot. 12 (1936) 386.

Hondo: m. Tsukuba in Hitachi (Y. TSURUMACHI), m. Asama (U. FAURIE n. 8021), Kanayama in Iwaki (T. SUZUKI).

Korea: Schin Ku Kai, prope Seoul (SONTAG in HP), ins. Quelpaert (J. OHWI n. 9201; U. FAURIE n. 1787; E. TAQUET n. 2661 et 1452 in HB, n. 2959), m. Chiisan (J. OHWI n. 6813), Kyurei (M. K. BOKU), Pomasa (U. FAURIE n. 594), prope San-kyo in Kannan (N. NOMURA).

This plant, first accurately described by PALIBIN l.c. and named by TAKEDA after him, is easily recognised by the fasciculate roots, the false

verticillate upper leaves, and by the solitary terminal chasmogamic flower with the quite glabrous pedicel.

3. *Pseudostellaria setulosa* OHWI in Journ. Japan. Bot. 12 (1936) 388.

*Krascheninnikovia setulosa* OHWI sched. in Herb. Imper. Univers. Kyoto.

Korea; m. Kongosan (J. OHWI n. 60), Osorei in Kannan (N. NOMURA).

This species, closely related to *P. heterophylla* and *P. Palibiniana*, is characterised, however, by the long-ciliated false-whorled upper leaves and by the solitary terminal flower with the puberulous pedicel.

4. *Pseudostellaria heterophylla* (MIQ.) PAX ex PAX et HOFFM. in ENGL. Pfl.-fam. ed. 2, 16c (1934) 318; KITAGAWA in Bot. Mag. Tokyo 49 (1935) 224.

*Krascheninnikovia heterophylla* MIQ. in Ann. Mus. Bot. Lug. Bat. 3 (1867) 187; MAXIM. in Mém. Biol. 9 (1873) 40; FRANCH. et SAVAT. Enum. Plant. Japan. 2 (1879) 298; KOMAR. in Act. Hort. Petrop. 22 (1903) 180; TAKEDA in Kew Bull. (1913) 88.

*Stellaria heterophylla* (MIQ.) HEMSL. in Journ. Linn. Soc. 23 (1886) 68; NAKAI Flor. Korean. 1 (1909) 87; LOESEN. in Beih. Bot. Centralbl. 37:2 (1919) 120, cum. t.

*Stellaria raphanorrhiza* HEMSL. in Journ. Linn. Soc. 23 (1886) 69; NAKAI Flor. Korean. 1 (1909) 87 ex pte.

*Krascheninnikovia raphanorrhiza* (HEMSL.) KORSH. in Bull. Acad. Imper. Sci. St. Pétersb. 9 (1898) 39; KOMAR. in Act. Hort. Petrop. 22 (1903) 180.

*Krascheninnikovia japonica* (non KORSH.) MAKINO in IINUMA Sô-moku-dzusetsu, rev. ed. 1 (1907) 396, t. 291.

*Krascheninnikovia coreana* NAKAI in Fedde Repert. 13 (1914) 268; OHWI in Journ. Japan. Bot. 12 (1936) 387, sub *Pseudostellaria*.

*Krascheninnikovia stellarioides* KOIDZ. Flor. Symbol. Orient. Asiat. (1930) 24, ex pte, excl. syn.

*Krascheninnikovia Koidzumiana* OHWI in Act. Phytotax. et Geobot. 3 (1934) 82 et 4 (1935) 33, sub *Pseudostellaria*.

*Pseudostellaria raphanorrhiza* (HEMSL.) PAX l. c. (1934) 318.

Kiushû: Machida, Kuzugun in Bungo (K. IKEBE).

Hondo: Omiyamichi in Musashi (S. MATSUDA), Shimura in Musashi (S. MATSUDA), Wada in Shinano (S. MATSUDA), Hanamiyama in Bitchiu (K. YAMAGUCHI), Akabane in Musashi (S. MATSUDA), Sekiyama in Iwaki (N. IMAI), Yonezaki in Rikuzen (S. SASAMURA), Utsushidake in Iwaki (M. YENDO).

Korea: Mokpo (U. FAURIE n. 2128), m. Chiisan (J. OHWI n. 6852, 6853; T. ISOMINE; M. K. BOKU), Seoul Mountains (CARLES, Phototyp. !), Kyurei (M. K. BOKU), Nam-san, urbe Seoul (U. FAURIE n. 156), Kan-yo

in Keinan (J. OHWI n. 9024), Tap Tong in Seoul (SONTAG in HP), ins. Quelpaert (K. NAKASHIMA).

Manchuria: Renzankan (K. YAMATSUTA), Fungshan (ROSS, Photot.), urbe Dairen (M. NAGASAWA).

China: Kiukiang or Chinkiang, in Kiangsu or Kiangsi (MARIES Photot.), Lauschan in Shantung (THÜNTZEL n. 75 in HB), Hoaynan in Shantung (KRUG n. 214 et HASS n. 97 in HB).

var. *puberula* OHWI var. nov.

Folia supra, margine, et subtus ad costas puberula a typo diversa.

Korea: Kan-yo in Keinan (J. OHWI sin. num.).

The Manchurian plants of this species have been recently divided by KITAGAWA l. c. into three varieties, according to the shape and incision of the petals. The upper two pairs of leaves are generally approximate, as if the leaves are verticillate, and no leafy branches shoot out from this part. But the pairs are rarely somewhat distant, and in this case, the inflorescence is also often more or less elongated to form an abbreviated dichasium rather than the false umbel. The cleistogamic flowers are usually very frequent, and often develop even up to the apical portion of the stem.

5. *Pseudostellaria Okamotoi* OHWI in Journ. Japan. Botan. 12 (1936) 387.

Korea: m. Chiisan (J. OHWI n. 6847, 6848; S. OKAMOTO).

6. *Pseudostellaria sylvatica* (MAXIM.) PAX ex PAX et HOFFM. in ENGL. Pfl.-fam. ed. 2, 16c (1934) 318.

*Krascheninnikovia sylvatica* MAXIM. Prim. Flor. Amur. (1859) 57 et in Mém. Biol. 9 (1873) 39 et in Act. Hort. Petrop. 9 (1890) 70; KORSH. in Bull. Acad. Imper. Sci. St. Pétersb. 9 (1898) 40; KOMAR. in Act. Hort. Petrop. 22 (1903) 176; TAKEDA in Kew Bull. (1913) 87; MURAVJ. in KOMAR. Flor. URSS. 6 (1936) 424, t. 22, f. 1.

*Stellaria sylvatica* (MAXIM.) REGEL Plant. Raddean. 1 (1862) 421, t. 9, f. 12-16.

Siberia orientalis: Amur (MAXIMOWICZ in HL, in HB, et in HP), Amuria, ca. Stationem Radde (KOMAROV n. 604 in HP et in HB).

Korea: m. Shajitsuho in Kannan (J. OHWI), m. Setsurei (J. OHWI n. 1972), m. Shishirei in Kampoku (J. OHWI n. 1186 et 1236), m. Kongsan (J. OHWI), m. Kamboho in Kampoku (J. OHWI; R. SAITO n. 855), Gekatsuguri in Kannan (J. OHWI).

Yezo: Akan (U. FAURIE n. 10703).

var. *retusa* OHWI var. nov.

Caules humiles 10-15 cm alti, folia margine altius ciliata, petala cuneata, apice leviter retusa.

China: Dongrergo in Sze-chu'an borealis (HARRY SMITH n. 3905).

Petals of the type form are slightly bifid at the apex, while those of the variety only slightly retuse. The plant cited by HANDEL-MAZZETTI in his *Symbolae Sinicae Anthophyta* (1929) 193 under the name of *K. sylvatica*, may belong to the variety rather than to the type.

7. *Pseudostellaria rigida* (KOMAR.) PAX ex PAX et HOFFM. in ENGL. Pfl.-fam. ed. 2, 16c (1934) 318.

*Krascheninnikovia rigida* KOMAR. in Bull. Jard. Bot. Pétersb. 16 (1916) 167; MURAVJ. in KOMAR. Flor. URSS. 6 (1936) 425, t. 22, f. 2.

Siberia orientalis: Ussuri (DESOUHAVY n. 1178 in HL).

This species, related to *P. sylvatica*, is characterised by the elongated rhizome, fasciculate rather slender roots, narrow rigid leaves, and the short pedicel.

8. *Pseudostellaria heterantha* (MAXIM.) PAX ex PAX et HOFFM. in ENGL. Pfl.-fam. ed. 2, 16c (1934) 318.

*Krascheninnikovia heterantha* MAXIM. in Mél. Biol. 9 (1873) 38 et in Act. Hort. Petrop. 9 (1890) 71; FRANCH. et SAVAT. Enum. Plant. Japon. 2 (1879) 297; KORSH. in Bull. Acad. Imper. St. Pétersb. 9 (1898) 40; MATSUM. Ind. Plant. Japon. 2:2 (1912) 83; TAKEDA in Kew Bull. (1913) 89; KOIDZ. Flor. Symbol. Orient. Asiat. (1930) 24.

*Krascheninnikovia rupestris* (non TURCZ.) MAXIM. in Mél. Biol. 9 (1873) 38, quoad pl. ex japon.; MATSUM. Ind. Plant. Japon. 2:2 (1912) 83 et pte.

*Arenaria vulcanorum* MAXIM. ex FRANCH. et SAVAT. Enum. Plant. Japon. 1 (1876) 59, nom. nud.

*Krascheninnikovia Maximowicziana* FRANCH. et SAVAT. Enum. Plant. Japon. 2 (1879) 297; MAXIM. in Act. Hort. Petrop. 9 (1890) 70 ex pte; KORSH. in Bull. Acad. Imper. St. Pétersb. 9 (1898) 40; TAKEDA in Kew Bull. (1913) 88.

*Stellaria rupestris* (non SCOP.) HEMSLE. in Journ. Linn. Soc. 23 (1886) 69, excl. syn.

*Stellaria Davidi* var. *himalaica* FRANCH. in Bull. Soc. Bot. Franc. 33 (1886) 434, excl. syn.

*Stellaria heterantha* (MAXIM.) FRANCH. Plant. Delavayan. (1890) 101.

*Krascheninnikovia himalaica* (FRANCH.) KORSH. in Bull. Acad. Imper. Sci. St. Pétersb. 9 (1898) 40, excl. specim.; HAND.-MAZZ. Symbol. Sinic. Anthoph. 1 (1929) 193.

*Krascheninnikovia heterantha* var. *linearifolia* TAKEDA in Not. Roy. Bot. Gard. Edinb. 39 (1915) 234 et in Bot. Mag. Tokyo 29 (1915) 191; NEMOTO Flor. Jap. Suppl. (1936) 200, sub *Pseudostellaria*.

*Pseudostellaria Maximowicziana* (FRANCH. et SAVAT.) PAX l. c.

*Pseudostellaria himalaica* (FRANCH.) PAX l. c.



Hondo: in m. Omine in Yamato (G. KOIDZUMI; S. SAKAGUCHI), m. Tsukuba in Hitachi (HILGENDORF in HB; Y. TSURUMACHI), Nikko (U. FAURIE n. 2442; CH. HASHIMOTO), Fujiyama (TANAKA; SAVATIER n. 133 et 133bis in HD; SAVATIER, sin. num. in HP; U. FAURIE n. 2441), m. Wata-muki in Omi (CH. HASHIMOTO), Itoshiro in Yetchizen (I. ITOSHIRO), m. Odai in Yamato (S. SAKAGUCHI), m. Ryugatake in Tamba (M. TAGAWA n. 168).

Shikoku: Osogoshitoge in Iyo (leg.), Nanokawa in Tosa (T. WATANABE), m. Tsurugi (U. FAURIE n. 3956).

Kiushiu: m. Ichifusa (K. MAYEBARA), m. Unzen (MAXIMOWICZ in HP; Z. TASHIRO), m. Sobosan (U. FAURIE sin. num.; H. KODZUMA), m. Hikosan in Buzen (Z. TASHIRO), Iwadamura in Hiuga (M. OGATA).

China: Kansu (PRZEWALSKI in HP), Mien-shan-yeh, distr. Chieh-hsin in Shansi centr. (HARRY SMITH n. 5896), Ta-hsing-ling in Sze-chu'an (HARRY SMITH n. 2024), Dongrergo in Szechu'an (HARRY SMITH n. 3635), distr. Tchen-kéou-tin in Su-tchuen orient. (FARGES in HD et HP), in umbrosis m. Koua-la-po, prope Hokin in Yunnan (DELAVAY n. 1035 et 1903 in HP), Fang-yan-tchang, supra Mo-so-yn in Yunnan (DELAVAY n. 2892 in HD).

var. *himalaica* OHWI var. nov.

*Stellaria bulbosa* (non WULF) EDGEW. et HOOK. f. in HOOK. f. Flor. Brit. India 1 (1874) 231, ex pte.

*Krascheninnikovia himalaica* KORSH. l.c. excl. syn.

Pedicelli calycesque parcissime puberuli.

India: Himalaya bor. occid. (T. THOMSON in HB), Konain 7000-8000 ped., Himalayae NW (DUTHIE n. 21002 in HB), Kashmir (AITCHISON in HL).

This plant was first erroneously described from rather young materials by MAXIMOWICZ l.c. as having the smooth seeds, and subsequently was named *K. Maximowicziana* by FRANCHET and SAVATIER on account of the mamillate seeds. The seeds are, in reality, more or less roughened with mamillae, though smaller and less conspicuous than those of the other species, and they look apparently smooth, when the materials are not mature enough.

*Stellaria Davidi* var. *himalaica* FRANCH., which was later on raised to the specific rank by KORSHINSKY, does not differ any way from this species, judging from the type, DELAVAY no. 1035, and other continental materials. The true Himalayan plants, however, are somewhat different from the typical form in the more glabrate nature, and then they may be referred to a variety.

9. *Pseudostellaria sessilifolia* (FRANCH.) OHWI comb. nov.

*Stellaria Davidi* var. *sessilifolia* FRANCH. Plant. Delavayan. (1890) 100.



*Radix tuberosa*. Caules breves erecti 3–10 cm alti. Folia inferiora minuta reducta, superiora ovata vel oblongo-ovata crassiuscula 10–15 mm longa 6–8 mm lata apice obtusa vel acutiuscula, basi obtusa subsessilia, utrinque glabra, margine basi tantum longiuscule ciliata. Flores chasmogamici foliorum superiorum axillis solitarii et terminales, pedicello folia superante unifariam puberulo, sepalis lanceolato-oblongis 4–5 mm longis acutis parce pubescentibus, petalis 8 mm longis obovato-cuneatis apice rotundato integris vel leviter retusis, antheris fusco-purpureis ellipticis minutis, stylis 2, versus apicem incrassatis. Flores cleistogamici ignoti. Capsula et semina ignota.

China: m. Lopin, Lankong, Prov. Yunnan (DELAVAY n. 2346 in HP).

*P. sessilifolia* is very different from *P. Davidi* in having the low habit, thick ovate subsessile leaves suddenly contracted at the base. The roots are tuberiferous. I reckon this plant a species of this genus with some doubt, as the cleistogamic flowers and the seeds are not yet observed.

10. *Pseudostellaria japonica* (KORSH.) PAX ex PAX et HOFFM. in ENGL. Pfl.-fam. ed. 2, 16c (1934) 318.

*Krascheninnikovia japonica* KORSH. in Bull. Acad. Imper. St. Pétersb. 9 (1898) 40; KOMAR. in Act. Hort. Petrop. 22 (1903) 178; MURAVJ. in KOMAR. Flor. URSS. 6 (1936) 425, t. 22, f. 3.

*Krascheninnikovia ciliata* HONDA in Bot. Mag. Tokyo 45 (1931) 1.

Hondo: Nambu (TSCHONOSKI in HL, sub nom. *K. heterophylla* in HD), Yanagawamura in Rikuchiu (Y. FUKUDA), Otakineyama in Iwaki (M. YENDO).

Manchuria: Uschagin, ad fl. Suifun (KOMAROV in HP).

*P. japonica* is characterised by the ovate subsessile long-ciliated upper leaves with rounded base. The upper pairs of leaves are always more or less distinct from each other.

11. *Pseudostellaria tibetica* OHWI sp. nov.

*Radix fibrosa* (tuberosa?). Caules 5–20 cm alti tenues erecti bifariam puberuli. Folia inferiora longius, superiora breviter petiolata ovata vel oblonga membranacea, supra interdum parce puberula, subtus glabra, margine pilis brevibus ciliata, basi acuta vel subcuneata, apice obtuso saepe breviter apiculata, excluso petiolo 1.5–3 cm longa, 7–15 mm lata. Flores chasmogamici pauci terminales et in axillis foliorum superiorum solitarii, pedicellis 2–3 cm longis unifariam puberulis folia sua superantibus tenuibus, sepalis 5 glabrescentibus lanceolatis acutissimis ca. 5 mm longis, petalis 5 cuneato-obovatis ca. 6 mm longis, apice rotundatis integris, filamentis subulatis 3–4 mm longis, stylis apice clavato-incrassatis. Flores cleistogamici in foliorum inferiorum axillis subsessiles, sepalis 4 sparse pubescentibus subinaequilongis, petalis nullis, capsula globosa 2.5–4 mm crassa oligosperma, stylo brevissimo. Semina subcompressa elliptica 1.2 mm longa 1 mm lata fusca perdense minute tuberculosa, tuberculis conicis

apice in spinulam unicam brevem abrupte abeuntibus.—A *P. heterantha* PAX, foliis latioribus margine ciliatis, floribus cleistogamicis subsessilibus, et a *P. Davidi* PAX et *P. eritrichioides* OHWI, caule erecto, floribus cleistogamicis subsessilibus, calyce floris chasmogamici glabrescente differt.

China: Tongolo, Latsa in Tibet orient. (SOULIÉ n. 2507 in HB).

This is near to *P. heterantha* in general appearance, but the leaves are somewhat broader and short ciliate. The cleistogamic flowers are, as far as the specimen shows, subsessile. If the lateral shoots of this plant elongate after the flowering time, this plant may come nearest to *P. eritrichioides*, which, however, has more longer-ciliated leaves and usually long-pedicelled cleistogamic flowers.

12. *Pseudostellaria Davidi* (FRANCH.) PAX ex PAX et HOFFM. in ENGL. Pfl.-fam. ed. 2, 16c (1934) 318; KITAGAWA in Bot. Mag. Tokyo 49 (1935) 223.

*Krascheninnikovia Davidi* FRANCH. Plant. Davidian. 1 (1884) 51, t. 10, incl. var. *stellarioides* et *flagellaris* FRANCH.; KORSH. in Bull. Acad. Imper. Sci. St. Pétersb. 9 (1898) 39; KOMAR. in Act. Hort. Petrop. 22 (1903) 177; TAKEDA in Kew Bull. (1913) 88; KOMAR. et K. ALIS. Key Plants Far East. Reg. USSR. 1 (1931) 494; MURAVJ. in KOMAR. Flor. URSS. 6 (1936) 426.

*Stellaria Davidi* (FRANCH.) HEMSL. in Journ. Linn. Soc. 23 (1886) 67; NAKAI Flor. Korean. 1 (1909) 87.

*Krascheninnikovia Maximowicziana* var. *Davidi* (FRANCH.) MAXIM. in Act. Hort. Petrop. 9 (1890) 70.

*Stellaria trimorpha* NAKAI in Bot. Mag. Tokyo 26 (1912) 327.

*Krascheninnikovia Maximowicziana* (non FRANCH. et SAVAT.) KOMAR. in Act. Hort. Petrop. 22 (1903) 178; TAKEDA in Kew Bull. (1913) 88 ex pte.

*Krascheninnikovia bulbosa* NAKAI in Bot. Mag. Tokyo 35 (1921) 133.

*Krascheninnikovia stellarioides* (FRANCH.) KOIDZ. Flor. Symbol. Orient. Asiat. (1930) 24 ex pte.

Siberia orientalis: Amuria in Burejae montibus (TURCZANINOV, ex pte, sub nom. *K. rupestris* in HB).

Manchuria: Gehol (DAVID in HP), inter Ninguta et Omoso, prov. Kirinensis (KOMAROV n. 605 in HP), ad fl. Sedemi (M. JANKOWSKI, sub nom. *K. Maximowiczianae* in HP et in HB), Howozan (K. YAMATSUTA).

Korea: Musan-lien (KOMAROV n. 605 in HB), Shuotsu (J. OHWI n. 349), m. Chiisan (J. OHWI n. 6845, 6846, 6850; S. OKAMOTO), m. Myokosan in Heihoku (G. KOIDZUMI), Kan-ouen-to (U. FAURIE n. 147), m. diamantino (U. FAURIE n. 593; J. OHWI), Seisuiira (J. OHWI n. 500), Kyojo (R. SAITO n. 515), ins. Quelpaert (K. NAKASHIMA).

This plant is strongly dimorphic. The stem is short and erect at the beginning of the anthesis, but later on, the lateral shoots are much elongated and reclined on the ground. *K. Maximowicziana* reported by KOMAROV l. c. based on a specimen collected by JANKOWSKI at Sedemi, Southern Manchuria, is nothing but a young plant of this species, as far as the duplicate collections kept in the herbaria of the Paris Museum and the Botanical Museum, Berlin-Dahlem, are concerned. Indeed, the young plant of this species is apt to be mistaken for *P. heterantha*, but it is easily distinguished from the latter by the pubescence of the calyx.

13. *Pseudostellaria eritrichioides* (DIELS) OHWI comb. nov.

*Krascheninnikovia eritrichioides* DIELS in ENGL. Bot. Jahrb. 36 Beibl. 82 (1905) 37.

*Stellaria eritrichioides* (DIELS) PAMPAN. in Nouv. Giorn. Bot. Ital. n. s. 22 (1915) 284.

China: Kan-y-san in Shensi sept. (GIRALDI n. 2602 in HB). Lu-yah-shan in Shansi centr. (HARRY SMITH n. 8252), Cho-mei-shan in Shansi (HARRY SMITH n. 5633), Ye-cho-shan in Shansi (HARRY SMITH n. 6381), Tahsian-ling in Sze-chu'an (HARRY SMITH n. 2139), Hsiao-wutaishan in Chihli (HARRY SMITH n. 617).

*P. eritrichioides* is closely related to the preceeding, from which it is, however, distinguished by long-ciliated upper leaves. GIRALDI no. 2602 consists of a few erect flowering plants attaining about 10–15 cm height, but the rich materials collected by Dr. HARRY SMITH prove that this species bears the elongated reclined lateral shoots after flowering, just as in *P. Davidi*.



# *Monachosorum* and *Ptilopteris*

By Motozi TAGAWA

With 12 text-figures

(Received May 31, 1937)

## I. *MONACHOSORUM* KUNZE

Type species: *M. davallioides* KUNZE = *Aspidium subdigitatum* BL.

*Monachosorum* KUNZE in Bot Zeit. 6, 119 (1848); MOORE, Ind. Fil. LXX (1857); KUHN, Chaetopt. 24 (1882); CHRIST, Farnkr. 76 (1897); DIELS in ENGLER u. PRANTL, Nat. Pflanzenfam. I-4, 218 (1899); C. CHR., Ind. Fil. XXIX (1906); Suppl. III. 7 (1934); COPEL. in Univ. Calif. Publ. Bot. 16, 55 (1929).

Rhizoma breviter repens vel oblique erectum, non squamatum, pilis simplicibus ferrugineis vestitum, cum dictyostelis. Frondes caespitosae, spirali collocatae. Stipes inarticulatus, cum rachide pilis simplicibus ferrugineis vestitus. Lamina tenuiter herbacea, bi- ad quinque-pinnata, supra glabra, subtus pilis glandulosis ad venas venulasque parce vestita; rachide ad axillas pinnarum I ord. mediarum vel superiorum bulbifera vel apice radicante et vivipara; venis venulisque liberis, ad marginem non attingentibus. Sori rotundati, exindusiati, terminales vel subterminales, oligocarpi, paraphysiati; annulis incompletis, verticalibus vel subobliquis; stomiis cellulis 4 compositis; stipitibus sporangiorum brevioribus quam capsulis, cellulis triseriariis compositis; sporis trilobato-tetraedris, facie granulatis.

A small genus of doubtful affinity, comprising four terrestrial species. The geographical range is from Malaysia, India and China, eastwards to Formosa and Japan.

As to the affinity of *Monachosorum* I fall in with BOWER's view<sup>(1)</sup>. He assigned its place with the marginal series, as a derivative of the *Dennstaedtiinae*, probably along a line parallel to that of *Hypolepis*. From the anatomical point of view HAYATA<sup>(2)</sup> compared *M. subdigitatum* KUHN with some dryopteroid ferns including *Dryopteris aurita* C. CHR. and *D. ochthodes* C. CHR., and with *Acrophorus stipellatus* MOORE in the presence of the axillary bulbils. I can not support his comparison, because *Monachosorum* has no scales and its spores are tetrahedral.

(1) BOWER, Ferns 3, 13, 254 (1928).

(2) HAYATA in Bot. Mag. Tokyo 42, 305 (1928).





## 2. *Monachosorum subdigitatum* KUHN (Fig. 2, 3)

*Monachosorum subdigitatum* (BL.) KUHN, Chaetopt. 25 (1882); CHRIST, Farnkr. 76, f. 199 (1897); in Bull. Herb. Boiss. 6, 868 (1898); DIELS in ENGLER u. PRANTL, Nat. Pflanzenfam. I-4, 218, f. 117 B, F (1899); COPEL., Polypod. Philipp. 58 (1905); v. A. v. R., Mal. Ferns 485 (1908); HAYATA in Bot. Mag. Tokyo 23, 28 (1909); MAKINO et NEMOTO, Fl. Jap. 1636 (1925); HAND.-MAZZ., Symb. Sinic. 6, 30 (1929); C. CHR. in Contr. U. S. Nat. Herb. 26, 295 (1931); in Gard. Bull. 7, 226 (1936); WU, WONG et PONG, Polypod. Yaosh. 126, pl. 54 (1932).

*Aspidium subdigitatum* BL., Enum. 171 (1828).

*Polypodium subdigitatum* BL., Fl. Jav. Fil. 196, t. 93 (1829); HOOK. et BAK., Syn. Fil. 340 (1867); BEDD., Ferns Brit. Ind., pl. 229 (1867); Suppl. 21 (1876); CLARKE in Tr. Linn. Soc. II. Bot. 1, 546, pl. 80, f. 2 (1880).

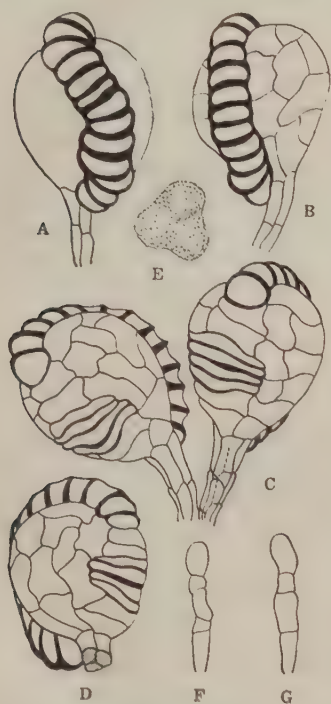


Fig. 2. *Monachosorum subdigitatum* KUHN. A-D=sporangia from three aspects. E = spore. F, G = hairs on vein.



Fig. 3. Tertiary pinnae of *Monachosorum subdigitatum* KUHN.  $\times 3$ .

*Gymnogramma subdigitatum* KEYS., Pol. Cyath. Hb. Bung. 31 (1873).

*Phegopteris subdigitatum* BEDD., Handb. 295 (1883).

*Monachosorum davallioides* KUNZE in Bot. Zeit. 6, 119 (1848).

*Polypodium davallioides* METT., Fil. Lips. 30 (1856); HOOK., Sp. Fil. 4, 256 (1862).

Hab. From Malaysia to India, China and Formosa. I have examined the following specimens:—

Formosa. Prov. Sintiku: Mt. Rokuzyô-taisan (Y. SIMADA! No. 4911. *Apr. 19, 1930*). Prov. Taityû: inter Hôsyâ et Numanohira (M. TAGAWA! No. 512. *Aug. 19, 1934*). Prov. Tainan: Mt. Arisan (T. ITÔ! *June 29, 1912*); Bunkikiyo (Hunkiko) (U. FAURIE! No. 394. *May 1914*); Suizan in Arisan (S. NAGASAWA! *Oct. 30, 1905*; M. TATEWAKI! *Mar. 23, 1932*). Prov. Takao: near Matuyama (J. OHWI! *May 1933*); Mt. Daibu (J. OHWI! No. 1996. *May 10, 1933*).

China. Yaoshan, Kwangsi (SIN! No. 174. *May 28, 1928*).

For this distinct and well known species a detailed description is not necessary. Lamina is quinque-pinnate. Sorus contains few paraphyses which are isomorphic with hairs on under side of veins and veinlets; annulus is incomplete, vertical or slightly oblique, and straight or often irregular; stomium is composed of 4 cells with slightly thickened walls; stalk of sporangium shorter than the capsule and consists of three cell-rows; spore is trilobate-tetrahedral and its surface is granular. These soral characters are also applicable to the following two species, and most probably to *M. gracile* COPEL.

var. **Henryi** (CHRIST) TAGAWA, comb. nov. (Fig. 4)

*Monachosorum Henryi* CHRIST in Bull. Herb. Boiss. 6, 869 (1898); DIELS, l. c.; WU, WONG et PONG, l. c. 128. pl. 55.

Lamina tripinnate. Secondary pinnae pinnate, rachises narrowly winged. Tertiary pinnae cut into several close oblique obtuse or shortly apiculate ultimate segments. Axillary bud is found in the type specimen.

Hab. China (Yunnan, Kwangsi, Kweichow). I have examined the following specimen:—

Yaoshan, Kwangsi (SIN! No. 444 A. *June 11, 1928*).

### 3. *Monachosorum Arakii* TAGAWA (Fig. 5, 6, 7)

*Monachosorum Arakii* TAGAWA in Acta Phytotax. Geobot. 4, 132 (1935).

Rhizoma breviter repens, brunneum, reliquis stipitum obtectum, frondibus caespitosis. Stipes 55–60 cm. longus, ca. 5 mm. basi latus, supra sulcatus, viridi-stramineus, basi ferrugineus, tota longitudine furfuraceo-pilosus, pilis ferrugineis vel brunneis. Lamina ovato-lanceolata vel triangulari-ovata, acuminata, 50–70 cm. longa, 25–40 cm. lata, tenuiter herbacea, tripinnata; rachide viridi-straminea, parce furfuraceo-pilosa, supra sulcata, supra medium ad axillas pinnarum I ord. bulbifera. Pinnae I ord. lanceolatae, apice longe acuminatae plus minus caudatae, basi truncatae breviter petiolulatae, a rachide angulo 60°–70° divaricatae,

pinnis I ord. maximis saepe ad 30 cm. longis, 10 cm. latis; pinnis II ord. lanceolatis, apice acutis vel acuminatis, basi oblique truncatis sessilibus, horizontaliter patentibus, rachidibus pinnarum II ord. angustissime alatis, subtus parce glanduloso-pilosis, pinnis II ord. maximis saepe ad 7 cm. longis, 1.5 cm. latis; pinnis III ord. oblongis vel ovatis, apice obtusis, basi oblique cuneatis sessilibus, latere superiore ad rachidem pinnarum II ord. parallelis, margine inciso-crenatis vel pinnatifidis, supra glabris, subtus ad venas venulasque parce glanduloso-pilosis, lobis obovatis vel ovalis



Fig. 4. Secondary pinna  
of *Monachosorum subdigitatum*  
KUHN var. *Henryi* TAGAWA  
×3.

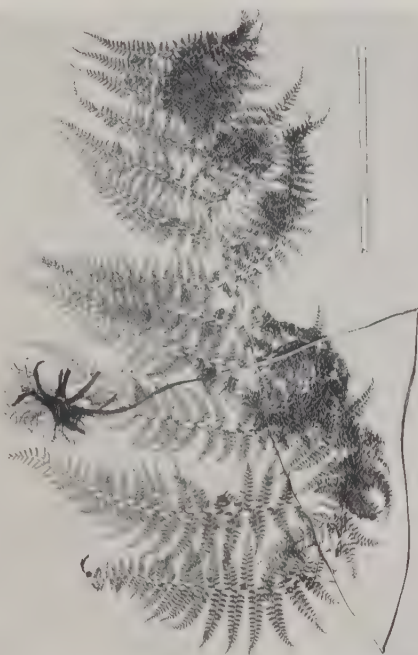


Fig. 5. *Monachosorum Arakii* TAGAWA.  
Type, in Herb. Kyôto Imp. Univ.

apiculato-acutis, pinnis III ord. maximis saepe ad 10 mm. longis, 5 mm. latis. Sori subterminales, rotundati, 0.5 mm. in diametro; sporis trilobato-tetraedris, granulatis, paraphysibus paucis, aliis pilis pinnarum ultimorum.

Hab. Endemic in Japan. Honsyû. Prov. Tanba: Mt. Tyôrô-ga-dake (Y. ARAKI! No. 1372. Aug. 27, 1933. Type in Herb. Kyôto Imp. Univ.).

This species is entirely the same in its habit with *M. subdigitatum* KUHN. In the dissection of frond *M. Arakii* TAGAWA is closely resembling



to *M. subdigitatum* var. *Henryi* TAGAWA, but differs from it only in the shape of teeth or ultimate segments. In *M. Arakii* TAGAWA teeth are distinctly apiculate-acute at the apex, while in *M. subdigitatum* KUHN and var. *Henryi* TAGAWA they are obtuse or obscurely apiculate at the apex. As to the segregation of this species from *M. subdigitatum* KUHN and its allies I am not quite sure.

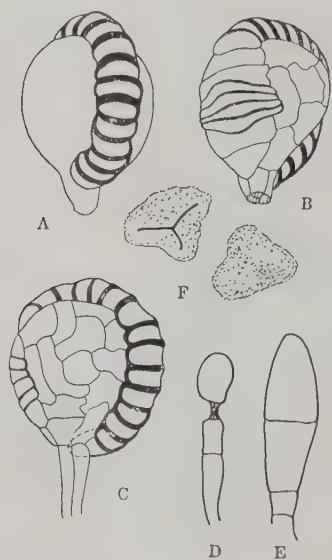


Fig. 6. *Monachosorum Arakii* TAGAWA. A-C = sporangia from three aspects. D, E = hairs on vein. F = spores from two aspects.



Fig. 7. Secondary pinna of *Monachosorum Arakii* TAGAWA.  $\times 3$ .

#### 4. *Monachosorum flagellare* HAYATA (Fig. 8, 9, 10)

*Monachosorum flagellare* (MAXIM.) HAYATA in Bot. Mag. Tokyo 23, 29 (1909).

*Polypodium flagellare* MAXIM. ex MAKINO in Bot. Mag. Tokyo 4, 454 (1890), nom. nud.



*Phegopteris flagellaris* MAKINO in Bot. Mag. Tokyo 9, 181 (1895), nom. nud.

*Ptilopteris flagellaris* MAKINO in Bot. Mag. Tokyo 13, 56 (1899).

*Polystichum flagellare* MATSUM., Ind. Pl. Jap. 1, 342 (1904); C. CHR., Ind. Fil. 581 (1906); MAKINO et NEMOTO, Fl. Jap. 1657 (1925).

*Monachosorella flagellaris* HAYATA in Bot. Mag. Tokyo 41, 540 (1927).

*Monachosorum nipponicum* MAKINO in Bot. Mag. Tokyo 23, 246 (1909); MAKINO et NEMOTO, l. c. 1636.

*Monachosorella nipponica* HAYATA in Bot. Mag. Tokyo 41, 540 (1927).

*Monachosorella flagellaris* var. *nipponica* TAGAWA in Acta Phytotax. Geobot. 1, 88 (1932).

Hab. Endemic in Japan. I have examined the following specimens:—

Honsyû. Prov. Simotuke: Mt. Ozaku-san, Kasomura (T. SUZUKI! Nov. 10, 1929). Prov. Mino: Mt. Kinkwa-zan, Gihu (M. TAGAWA! No. 580. Nov. 27, 1932); Otohimebora near Hatiman (Z. TASIRO! July 22, 1935); Mt. Sitisô-zan (K. SIODA! Apr. 28, 1935). Prov. Wakasa: Itinotani

(Z. TASIRO! June 30, 1934). Prov. Ômi: Syozyo-ko near Imazu (H. WATANABE! Sept. 5, 1927). Prov. Tanba: Tii-mura (M. TAGAWA! No. 648. July 28, 1933); Yuge-mura (M. TAGAWA! No. 657. July 27, 1933); Uhara-mura (Y. ARAKI! June 14, 1931); Kamiotomi, Kamiwati-mura (K. TAKEUTI! July 29, 1929); Kusayama-mura (Y. ARAKI! July 20, 1930). Prov. Yamasiro: Ôharano-mura (H. YAMAMOTO! No. 44. Mar. 19, 1933); Hanase-mura (Z. TASIRO! May 15, 1929). Prov. Bittyû: Mt. Tenzin-yama, Kawakami-gun (Z. TASIRO! Aug. 14, 1932). Prov. Aki: Isl. Miya-zima



Fig. 8. *Monachosorum flagellare* HAYATA. Frond on the left side: bipinnate frond, viviparous at the apex. Frond on the right side: subtripinnate frond, viviparous at the apices of lamina and pinnae. Frond with rhizome: *M. nipponicum* MAKINO.

(K. HUKUDA! *Feb. 1933*). Prov. Kawati: Mt. Iwaki-san (Z. TASIRO! *July 8, 1928*). Prov. Yamato: Murô (T. KUROKAWA! *Aug. 1, 1932*). Prov. Kii: Nati (M. TAGAWA! No. 390. *Oct. 12, 1931*); Kodokoro, Kamikawamura (T. KOIDE! *Aug. 20, 1932*); Yomura (N. UI! *June 23, 1909*).

Sikoku. Prov. Tosa: Mt. Kuisi (E. UEMATU! *Apr. 23, 1905*; H. YAMAMOTO! *Apr. 22, 1905*); Mt. Irazu (H. YAMAMOTO! *Aug. 3, 1914*). Prov. Iyo: Mt. Odamiyama (Y. DOI! No. 214. *Aug. 26, 1927*; Z. TASIRO! *Aug. 26, 1927*). Prov. Awa: Mt. Tairyûzi-yama near Tokusima (Z. TASIRO! *Aug. 18, 1930*).

Kyûsyû. Prov. Tikuzen: Mt. Hôman-zan (T. SUGINO! *Sept. 7, 1924*; Y. NABESIMA! *May 18, 1927*). Prov. Higo: Mt. Ôhira (K. MAEBARA! No. K 728. *Oct. 26, 1930*); Kônose (K. MAEBARA! *Sept. 28, 1924*); Uemura (K. MAEBARA! *Sept. 28, 1918*); Mt. Itihusa (K. MAEBARA! *Aug. 7, 1916*). Prov. Hyûga: Iwado-mura (Z. TASIRO! *Aug. 24, 1915*); Kawano-tume (Z. TASIRO! *Aug. 26, 1923*). Prov. Satuma: Mt. Zyussô-zan (Y. DOI! No. 124. *Aug. 27, 1936*).

This species was excellently described and published by Dr. MAKINO and it is not necessary to rectify his original diagnosis.

"Caudex short, repent, with the basal remains of old stipes and hard capillaceous roots. Stipes caespitose, generally 4-5 in number, shorter than the frond and 6-28— sometimes 37 cm. long, slender, canaliculate in front, castaneous-brown, sparse with deciduous and very minute glandular hairs throughout. Frond lanceolate or narrowly deltoid, much prolonged towards the apex, which is often rooting and viviparous, bipinnatisect, or tripinnatifid when well developed, 25-67 cm. long, 7-20— sometimes 28 cm. broad, thin, herbaceous, olivaceous when dry, naked on the upper surface, but scattered with very minute glandular hairs beneath; pinnae numerous, alternate, usually horizontally patent, or sometimes more or less reflexed, moderately close, pinnatisect or sometimes bipinnatifid, but pinnatifid above, pinnatifid in the superior ones, lanceolate, sessile, attenuated towards an obtuse apex, gradually decreasing in size upwards and uppermost ones much reduced into very minute segments about 1 mm. in length, larger ones 9.5-16 cm. long, 2-4.5 cm. wide, the rachis margined with very narrow wings which are decurrent from pinnules; numerous, regularly arranged, patent, moderately close, rhomboid-triangular-lanceolate, or rhomboid-ovate, subsessile, obtuse, obliquely cuneate or broadly cuneate at the base, upper lower edge parallel to the rachis, pinnatifid or pinnati-partite into 3-10 entire or paucicrenate-dentate ovate-oval segments on each side, but crenato-pinnatifid in the superior ones, upper lower segments larger, larger pinnules 12-25 mm. long, 7-10 mm. broad; veins flexuous, pinnate; veinlets erect-patent, loose, 1-10 on each side, simple or bifurcate, or pinnate in well developed ones; main

rachis slender, canaliculate in front, stramineous, dispersed with minute glandular hairs as it is the case with the stipe. Sori small, punctiform, yellow, terminating the veinlets, which are stopping before reaching to the margin, 1-3- sometimes 5 to a segment, but often 4-5- or 8 to the upper lower segments."

*M. flagellare* HAYATA is separable from *M. subdigitatum* KUHN and its allies by the less compound and smaller frond, the absence of axillary bulbils, and the anadromically arranged secondary pinnae. Lamina is bi-

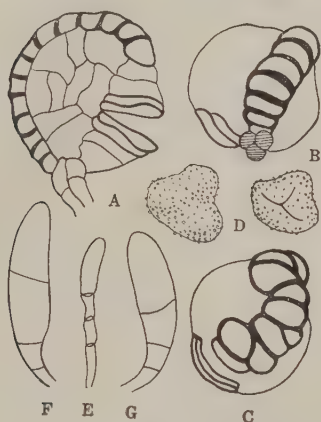


Fig. 9. *Monachosorum flagellare* HAYATA. A-C=sporangia from three aspects. D=spores from two aspects. E-G=hairs on vein.



Fig. 10. Secondary pinnae of *Monachosorum flagellare* HAYATA.  $\times 3$ .

to tri-pinnate and is generally much prolonged towards the apex, which is often rooting and viviparous. Sometimes the apex is repeatedly divided and bears bulbils, some of them are axillary in origin. The apices of primary pinnae are often in the same condition. The sclerotic masses between meristeles and medullary strand of sclerotic cells are also found in this species. *M. nipponicum* MAKINO (Fig. 8. Plant with rhizome) is an extreme form with tripinnatifid or subtripinnate fronds which are not much prolonged and not viviparous at the apex. There are many intermediate forms between typical *M. flagellare* HAYATA and *M. nipponicum* MAKINO.

## II. *PTILOPTERIS* HANCE

*Ptilopteris* was founded by HANCE in 1884 to receive two species known to him—*Pt. Hancockii* n. sp., there described, and *Pt. Maximo-*

*wiczii* (BAK.), already described under *Polypodium* by BAKER. His generic diagnosis is as follows:—

“Sorus rotundatus, exindusiatus, terminalis in apice haud incrassato nervi singuli. Petiolus rhizomati continuus. Filices caespitosae, foliis pinnatisectis, paleis cystopteroides praeditae. Japoniae et Sinae incolae.”

COPELAND<sup>(1)</sup> is of opinion that HANCE set up the genus fitting to *Pt. Maximowiczii*. But HANCE's generic diagnosis is not perfectly applicable to *Pt. Maximowiczii*, nor to *Pt. Hancockii*. “Sorus exindusiatus” applies to *Pt. Maximowiczii*, but not to *Pt. Hancockii*, and “paleis cystopteroides” fits to *Pt. Hancockii*, but not to *Pt. Maximowiczii*. *Pt. Hancockii* is a member of *Polystichum* and its indusia are fugaceous. I suppose, therefore, that HANCE set up the genus fitting to *Pt. Hancockii*.

Thirteen years later this genus was merged by CHRIST<sup>(2)</sup> as a section of *Phegopteris* so as to include only *Pt. Maximowiczii*. His diagnosis is as follows:—

“Nervatur frei, einfach, Nerven nur in Öhrchen an der Basis der Fieder gegabelt. Sori randständig an der Spitze der Zähne und am Ende der Nerven, rund, klein.”

The reasonable cause, therefore, seems to be to recognize *Pt. Maximowiczii* as the type species of *Ptilopteris*.

In 1927 HAYATA<sup>(3)</sup> created a new genus, *Monachosorella*, for *Polypodium Maximowiczii* BAK. He attached great importance to the inner structure. Hence *Ptilopteris* and *Monachosorella* are typonyms. The first name, having priority, is valid, the second being a synonym.

*Ptilopteris* may be a derivative of the *Dennstaedtiinae*, probably along a line parallel to that of *Monachosorum*. The affinity of these two genera is proved by the similarity of their sori, spores, habit, and presence of hairs, not scales. The unipinnate frond, the characteristic venation, and the stomium composed of six cells are not found in *Monachosorum*. HAYATA<sup>(3)</sup> placed his new genus, *Monachosorella*, next to *Monachosorum*, and then *Polypodium Maximowiczii* BAK. was given the long-expected and natural position. COPELAND<sup>(4)</sup> recognizes *Ptilopteris* as a distinct genus, but he says that its origin is very probably in or near *Cystopteris*, whether or not through *Woodsia*, and that it is not related to *Polypodium*, where first described, nor very closely to *Polystichum*, not to *Monachosorum*, to both of which it has been referred.” *Cystopteris* is distinctly different from *Ptilopteris* by the presence of scales and the bilateral spores.

(1) COPELAND in Univ. Calif. Publ. Bot. **16**, 57 (1929).

(2) CHRIST, Farnkr. 271 (1897).

(3) HAYATA in Bot. Mag. Tokyo **41**, 573 (1927).

(4) COPELAND in Univ. Calif. Publ. Bot. **16**, 57 (1929).



***Ptilopteris* HANCE, emend.**

Type species: *Polypodium Maximowiczii* BAK.

*Ptilopteris* HANCE in Journ. Bot. 22, 138 (1884); COPEL. in Univ. Calif. Publ. Bot. 16, 57 (1929).

*Phegopteris* § *Ptilopteris* CHRIST, Farnkr. 271 (1897).

*Polystichum* § *Eupolystichum* DIELS in ENGLER u. PRANTL, Nat. Pflanzenfam. I-4, 189 (1899), pro parte.

*Polystichum* § *Ptilopteris* C. CHR. Ind. Fil. XXIV (1906).

*Monachosorella* HAYATA in Bot. Mag. Tokyo 41, 573, 642 (1927); in Flora 74, 44 (1929); C. CHR., Ind. Fil. Suppl. III. 7 (1934).

Rhizoma breviter ascendens, non squamatum, pilis minutis simplicibus ferrugineis vestitum, frondibus caespitosis. Dictyostela simplicissima. Stipes inarticulatus, basi pilis minutis adpressis instructus. Lamina tenuiter herbacea, lanceolata vel lineari-lanceolata, unipinnata; rachide saepe prolongata et apice prolifera; pinnis lanceolatis, auriculatis, inciso-crenatis, subtus pilis minutis parcissime dispersis vesiculaeformibus cellulis 2-3 uniseriatim dispositis constructis; venis basalibus acroscopicis pinnatis, ceteris simplicibus, ad apicem dentarum non attingentibus. Sori rotundati vel ovals, terminales vel subterminales, exindusiati, oligocarpi, paraphysiati; annulis incompletis, verticalibus vel subobliquis; stomiis cellulis 6 compositis; stipitibus sporangiorum cellulis triseriariis compositis; sporis tetraedro-sphaericis, facie granulatis.

Monotypic genus in Japan and Formosa.

There is no necessary of touching the anatomy of *Pt. Maximowiczii*, because it has been made clear by HAYATA<sup>(1)</sup>. The absence of sclerotic masses between meristemes and medullary strand of sclerotic cells is, I think, not so important to the generic character as he thought much of it.

***Ptilopteris Maximowiczii* HANCE (Fig. 11, 12)**

*Ptilopteris Maximowiczii* (BAK.) HANCE in Journ. Bot. 22, 139 (1884).

*Polypodium Maximowiczii* BAK. in HOOK. et BAK., Syn. Fil. ed. 2. 504 (1874); in HOOKER's Ic. Pl. 17, pl. 1667 (1886).

*Phegopteris Maximowiczii* CHRIST, Farnkr. 271 (1897).

*Polystichum Maximowiczii* DIELS in ENGLER u. PRANTL, Nat. Pflanzenfam. I-4, 189, f. 99 D-E (1899); MATSUM., Ind. Pl. Jap. 1, 343 (1904); C. CHR., Ind. Fil. 584 (1906).

*Monachosorum Maximowiczii* HAYATA in Bot. Mag. Tokyo 23, 29 (1909); KODAMA in MATSUM., Ic. Pl. Koisikav. 1, pl. 15 (1911); MAKINO et NEMOTO, Fl. Jap. 1636 (1925).

(1) HAYATA in Bot. Mag. Tokyo 41, 642-647 (1927).



*Monachosorella Maximowiczii* HAYATA in Bot. Mag. Tokyo 41, 540, 573, 705 (1927); OGATA, Ic. Fil. Jap. 1, pl. 35 (1928); YAMAM., Suppl. Ic. Pl. Formos. 5, 5 (1932).

*Monachosorum Maximowiczii* var. *melanocaulon* HAYATA, Ic. Pl. Formos. 6, 160 (1916); MAKINO et NEMOTO, l. c.

*Polystichum Maximowiczii* var. *melanocaulon* HAYATA, Ic. Pl. Formos. 6, 160 (1916), sub syn.

*Monachosorella Maximowiczii* var. *melanocaulon* HAYATA in Bot. Mag. Tokyo 41, 540 (1927).

Terrestrial fern in shady forest of mountain. Rhizome short, nearly

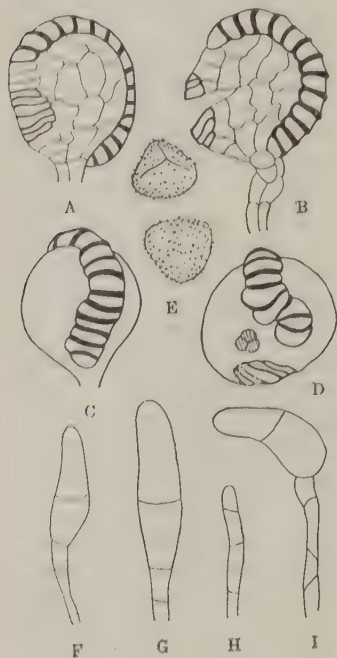


Fig. 11. *Ptilopteris Maximowiczii* HANCE. A-D = sporangia from three aspects. E = spores from two aspects. F-H = hairs on vein. I = paraphysis.

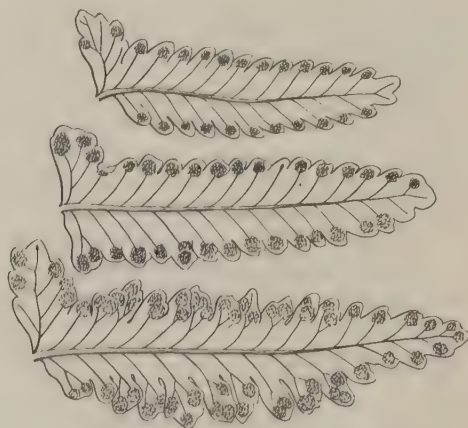


Fig. 12. Pinnae of *Ptilopteris Maximowiczii* HANCE.  $\times 2.5$ .

erect, bearing simple minute hairs, free from scales, containing a dictyostele not far removed from solenostely. Fronds caespitose erect, stipes brown polished, nearly glabrous together with stramineous rachis. Lamina thinly herbaceous but moderately firm in texture, lanceolate or linear-lanceolate, narrowed at both ends, simply pinnate; rachis generally much prolonged and rooting at the apex; pinnae numerous, close together, horizontally patent, sessile, lanceolate, obtuse or nearly acute, incisocrenate, auricled and parallel to the rachis on upper, cuneate-truncate on lower side at the base, many lower reduced and deflexed, upper surface

naked, lower surface bearing minute claviform hairs especially on costa and veins, veins simple rarely forked or pinnately branched near the apex, erect-patent, one to each tooth, not reaching to the apices of teeth, the lowest acropetal vein constantly pinnate, teeth often slightly recurved and covering the sori. Sori seated at or very near to the slightly enlarged end of a vein, yellowish, round or oval, exindusiate, about 2-3 mm. in diameter, mixed with few paraphyses ending in a slightly curved and elongated ovoid head, stalks of sporangia shorter than the capsules and composed of three cell-rows, annulus incomplete, vertical or slightly oblique, straight or often irregular, stomium consisting of 6 cells with slightly thickened walls, spores yellowish tetrahedral-spherical, surface granular.

Hab. Japan (Honsyû, Sikoku, Kyûsyû) and Formosa.

I have examined the following specimens:—

Honsyû. Prov. Izu: Mt. Amagi (Z. TASIRO! *Aug. 7, 1927*). Prov. Sinano: Mt. Ondake (U. FAURIE! No. 7227. *July, 1907*; M. NODA! *July 29, 1911*); Akaho-mura (H. SUZUKI! *Aug. 21, 1927*). Prov. Hida: Mt. Kasadake (Z. TASIRO! *Sept. 6, 1929*); Hâgihara (G. KOIDZUMI! *Sept. 25, 1933*). Prov. Mino: Otohimebora near Hatiman (Z. TASIRO! *July 22, 1933*). Prov. Ômi: Mt. Hira (T. HASIMOTO! *Aug. 22, 1927*). Prov. Yamasiro: Mt. Hiei (M. TAGAWA! No. 451. *July 15, 1932*; G. KOIDZUMI!); Hanase (Z. TASIRO! *May 15, 1929*); Sizuhara, Sizuitino-mura (S. AGÔ! *Oct. 1902*); Ôhara (M. TAGAWA! *July 14, 1929*); Mt. Kosio-yama, Ôharano-mura (H. YAMAMOTO! No. 45. *Mar. 19, 1933*); Kûya-no-taki at the foot of Mt. Atago (SINODA! *Jan. 25, 1929*). Prov. Tanba: Yuge-mura (M. TAGAWA! No. 156. *May 3, 1931*; S. HUSIMI! *Nov. 1919*). Prov. Yamato: Yosino (U. FAURIE! No. 224. *Sept. 1913*); Kamikitayama-mura (N. YASUI! No. 262. *May 31, 1931*); Mt. Ôdaigahara (T. KOIDE! *Aug. 1929*); between Misen and Sinohara (G. KOIDZUMI! *July, 1922*). Prov. Kii: Nati (N. UI! *Mar. 28, 1912*). Prov. Bittyû: Tenzin-yama, Kawakami-mura (Z. TASIRO! *Aug. 14, 1932*).

Sikoku. Prov. Tosa: Mt. Senbon-yama, Umazi-mura (M. TAGAWA! No. 913. *Aug. 20, 1930*); Hônokawa (S. ODA! *Aug. 1903*). Prov. Awa: Mt. Turugi (U. FAURIE! No. 4563. *June, 1900*). Prov. Iyo: Mt. Odami-yama (Z. TASIRO! *Aug. 26, 1927*; K. YAMASITA! *Oct. 21, 1923*; T. IMAIZUMI! *Oct. 18, 1925*); Mt. Isizuti (Y. DOI! No. 18. *Aug. 21, 1929*).

Kyûsyû. Prov. Hizen: Mt. Tara-dake (Z. TASIRO! *Oct. 20, 1935*). Prov. Bungo: Mt. Kuro-dake (Z. TASIRO! *Aug. 19, 1916*; *Sept. 6, 1927*). Prov. Hyûga: Iwado-mura (M. OGATA! *Apr. 4, 1913*).

Formosa. Prov. Kwarenkô: Mt. Asahi (Y. SIMADA! No. 5114 B. *Oct. 1918*). Prov. Taityû: Mt. Tugitaka (N. FUKUYAMA! No. 4364. *July, 1930*).

Finally I wish to express my sincere thanks to Prof. G. KOIDZUMI for his kind direction. It is also a pleasant duty to thank Prof. H. HUMBERT and Dr. TARDIEU-BLOT for their kindness in sending me the photograph and the fragments of the type specimen of *Monachosorum Henryi* CHRIST. My best thanks are also due to Dr. ETHEL K. CRUM, through whose kindness I have received the phototype of *M. gracile* COPEL. from the Herbarium of the University of California.

BOTANICAL INSTITUTE OF KYÔTO IMPERIAL UNIVERSITY,  
KYÔTO, JAPAN.

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## Abstracts Nos. 1-137

(Referring mostly to the principal papers in Botany and allied subjects which have appeared in Japan during July-December 1936)

**1. Kernphasenwechsel von *Heterochordaria abietina*.** Kôgorô ABE. (Sc. Rpts. Tôhoku Imp. Univ. 4th Ser. **11**, 1936, 239-241, 2 Taf.).

Die zytologische Untersuchung des Verfs. hat die Tatsache festgestellt, dass 1. die Individuen von *Heterochordaria abietina* mit unilokularen Sporangien diploid ( $2n =$  ungefähr 40) und dieselben mit plurilokularen haploid sind ( $n =$  ungefähr 20), und 2. die erste Kernteilung im unilokularen Sporangium eine Reduktionsteilung darstellt. Die zentrosomähnlichen Körperchen wurden bei dieser Teilung beobachtet.

**2. On the influence of the intensity of night illumination on some characters of wheat varieties.** (Japanese). Kôzô AKIHAMA. (Proc. Crop Sc. Soc. Japan **8**, 1936, 349-354, 3 text-figs.).

The results of the author's study concerning the influence of light intensity during the night illumination of wheat varieties which are, as well known, short-day plants, are contained in this paper. They were illuminated by means of one 200 W MAZDA tungsten-lamp which was hung down at about 1.8 m height above soil. A number of potted plants were placed in soil at various distances in concentric way around the lamp as the centre. The maximum illumination amounted to about 75 lux, and in plants placed in concentric way at various distances the illumination amounted to 80, 60, 40 and 20% of the maximum respectively. The illumination was begun every day at sunset and continued till next morning. It was practised till the shooting time.

These experiments have shown that parallel to the increase of light intensity the number of internodes, main culms and spikelets decreases, while the shooting time is accelerated. All such variations are variable in degree in different varieties.

**3. Mikrochemischer Nachweis der Flechtenstoffe I-II.** Yasuhiko ASAHINA. (Jour. Japan. Bot. **12**, 1936, 516-525, 859-872, 32 Textabb.).

Im allgemeinen Teil gibt der Verf. eine einfache Methode für den mikrochemischen Nachweis der Flechtenstoffe an. Sie besteht darin, dass eine bestimmte, reine Flechtensäure mittels eines geeigneten Lösungsmittels auf dem Objektglas umkrystallisiert oder mittels einer gewissen Base in Salz übergeführt wird, dann die auf diese Substanz zu prüfende Flechte mit demselben Lösungsmittel bzw. mit derselben Base unter genau denselben Bedingungen behandelt wird, und die so erhaltenen Krystallformen mit denjenigen des bekannten Stoffes verglichen werden.

Im speziellen Teil (von ASAHINA, M. MITUNO und Y. ABE bearbeitet) sind die folgenden Flechtenstoffe ausführlich behandelt: sowohl die Lecanor-, Gyrophor-, Anzia-, Olivetorsäure und das Erythrin, welche alle durch Chlorkalk sich rot färben, als das Atranorin, die Usnin-, Evern-, Divaricat-, Barbatin- und DiffRACTASäure, welche alle durch Chlorkalk sich nicht rot färben. Alle diese Stoffe kann man z.B. durch die Beobachtung der Gestalt und das Verhalten der respektiven Krystalle gegenüber verschiedenen Reagentien identifizieren, welche aus Glycerin-Alkohol-, Glycerin-Wasser-, Glycerin-Alkohol-Wasser-, oder Eisessig-Glycerinlösung derselben ausgeschieden werden. Für ausführliches sei auf das Original verwiesen.

**4. Über die Nomenklatur der japanischen Lungenflechte und deren Reaktion.** (Japanisch). Yasuhiko ASAHINA. (Jour. Japan. Bot. **12**, 1936, 567-569).

Ogleich die japanische Lungenflechte bisher im allgemeinen zu der europäischen Art *Lobaria pulmonaria* HOFFM. identifiziert wurde, gibt es jedoch zwischen beiden einige Unterschiede: die letztere bildet die Soredien aus und die Sporen sind zweizellig, während bei der ersteren es keine Soredien gibt und die Sporen vierzellig sind. Auch färbt sich das Markgewebe durch CaCl rot bei der japanischen Art, was auf das Vorhandensein von Gyrophorsäure hinweist, während bei der europäischen es keine solche Reaktion gibt. Bei von WAINIO als *meridionalis* genannten philippinen Art ist es bekannt, dass keine Soredien vorhanden und die Sporen vierzellig sind. Der Verf., welche *L. meridionalis* chemisch untersucht hat, hat dabei sicherlich die Anwesenheit der Gyrophorsäurekristalle nachweisen können, weshalb er bezüglich der Benennung der japanischen Lungenflechte als *L. pulmonaria* var. *meridionalis* ZAHLBRUCKNER beistimmt.

**5. Diagnose einiger Alectoriaarten durch die Diaminprobe.** Yasuhiko ASAHINA. (Jour. Japan. Bot. **12**, 1936, 687-690).

Der Verf. hat verschiedene Arten von *Alectoria*, und zwar besonders dieselben der Untergattung *Bryopogon* chemisch durch seine Diaminprobe untersucht. (S. Acta Phytochim. **8**, 1934, S. 477 u. Folg.). Dabei hat er drei Typen unterscheiden können, nämlich, 1. fast gar keine Färbung der Flecke durch Paraphenyldiaminlösung, was zeigt, dass keine auf diesem Reagenz reagierende Substanz vorhanden ist, 2. erst gelb und dann allmählich rot bis orangerot, was das Vorhandensein von Fumarprotocetrarsäure oder Protocetrarsäure zeigt, und 3. tiefgelb, nie rot.

Der Verf. gibt die Resultate seiner Untersuchungen über eine Anzahl von Arten an.

**6. Alectoria- und Oropogonarten aus Japan.** (Hauptsächlich in japanisch). Yasuhiko ASAHINA. (Jour. Japan. Bot. **12**, 1936, 690-693, 1 Textfigurengruppe).

Der Verf. hat die japanischen *Alectoria*-Arten aufgezählt, welche in erste Linie nach den morphologischen Merkmalen klassifiziert sind, jedoch auch mit der Berücksichtigung der chemischen. Das ganze steht wie folgt:

Genus *Alectoria*

A. Subgenus *Bryopogon*

I. Sec. *Jubatae* (*A. jubata* var. *lanestris*)

II. Sec. *Divaricatae*

Subsec. *Subfibrillosae* (*A. nidulifera*, *bicolor*, *acanthodes*, *asiatica*, *virens*, *divergens*, *divergens* var. *Satoana*)

Subsec. *Sulcatae* (*A. sulcata*)

B. Subgenus *Eualectoria* (*A. lata*, *lata* var. *subfibrillosae*, *A. ochroleuca*, *A. nigricans*)

Genus *Oropogon* (*O. loxensis*).

**7. Lichenologische Notizen (VIII).** (Japanisch, deutsch und lateinisch). Yasuhiko ASAHINA. (Jour. Japan. Bot. **12**, 1936, 802-809, 4 Textabb.).

*Cetraria pseudocomplicata* ist als eine neue Art beschrieben. 3 andere Arten (aus *Cetraria*, *Coriscium*, *Stereocaulon*) sind in diesem Aufsatz enthalten.

**8. Untersuchungen über die Bedeutung des Mannits im Stoffwechsel einiger höheren Pflanzen. Teil II.** Toichi ASAI. (Japan. Jour. Bot. **8**, 1937, 343-366, 6 Textfig. und 18 Tab.).



**9. Studien über die fossilen Diatomeen Japans I-II.** (Japanisch mit deutsch. Zfg.). Yoshikadzu EMOTO. (Jour. Japan. Bot. **12**, 1936, 507-516, 555-561, 1 Karte).

Vor allem hat der Verf. die geschichtliche Übersicht der Diatomeenforschung in Japan beschrieben, wonach unsere bisherige Kenntnisse in dieser Hinsicht nicht sehr umfangreich sind. Er hat tabellarisch die bisher in Japan aufgefundenen Diatomeengattungen mit ihren Fundorten und geologischen Straten angegeben. Auch sind alle bisher in Japan bekannten Diatomeenarten genannt.

**10. Myxomycetes of Jehol.** (Japanese and English). Yoshikadzu EMOTO. (Report of the first scientific expedition to Manchoukuo under the leadership of Shigeyasu TOKUNAGA, June-October 1933, Sec. IV, Part III, 1936, 4 pp, 1 pl.).

1 species, *Stemonitis splendens* ROSTAFINSKI is described with illustrations.

**11. New fossil species of Sequoia from the Far-East.** Seidô ENDÔ. (Proc. Imp. Acad. **12**, 1936, 172-175, 1 fig.-group).

Description of the three following new species, viz. *Sequoia japonica*, *rumoensis*, and *Onukii*. Cones or cones and leaves.

**12. A new Neogene species of Sassafras from Japan.** Seidô ENDÔ and Haruo OKUTSU. (Proc. Imp. Acad. **12**, 1936, 47-49, 1 fig.).

A description of fossil leaves of *Sassafras yabei* n. sp., which are similar to certain European Pliocene forms as well as to those of the living North American plant.

**13. Sclerotium Rolfsii SACC. in perfect stage IV. Cytological observations.** (With Japan. résumé). Kazuo GOTO. (Ann. Phytopathol. Soc. Japan **6**, 1936, 101-118, 1 pl. and 27 text-figs.).

The cells composing the vegetative hyphae and sclerotia of *Sclerotium Rolfsii* (perfect stage = *Corticium*) contain each generally more than two nuclei, and even in some cases 30-40. Those composing the subhymenial layer are principally binuclear, while the cells of the ultimate branchlets, though at first binuclear, later become to contain each one large nucleus derived from the fusion of the two nuclei. The clamps which are produced on leading hyphae, but never on immersed or wandering ones are each usually polynuclear (3-6 nuclei). Nuclear division of the clamp hyphae takes place usually in the neighbourhood of the clamp.

The diploid nuclear phase is restricted to the basidial cells containing one fusion nucleus. During the meiosis of the latter 4 haploid chromosomes are present, and the centrosome was observed. Though as a rule four basidiospores receive each one nucleus the migration of two into one single spore is probable. The single basidiospore isolates of the primary condition do not produce usually clamp hyphae, though exceptionally some of them may produce such hyphae.

**14. Preliminary report on the flora of Southern Hidaka, Hokkaido (Yezo) XIII-XVI.** (With Japan. résumé). Hiroshi HARA. (Bot. Mag. Tôkyô **50**, 1936, 363-370, 406, 419-425, 470, 489-496, 532, 562-570, 587).

**15. Observationes ad plantas Asiae orientalis XII.** (With Japan. résumé). Hiroshi HARA. (Jour. Japan. Bot. **12**, 1936, 792-802, 6 text-figs.).

The following new species are described among others: *Aconitum tonense*, *Scutellaria brachyspica*, *S. kiusiana*, *S. Maekawae*, *S. Muramatsui*.

**16. Die Entmischung des vitalgefärbten Zellsaftes bei *Sphaerotheca fuliginosa* (SCHLECHT.) POLL.** (Japanisch). Yoshio HASHIOKA. (Jour. Japan. Bot. **12**, 1936, 683-686, 5 Textabb.).

Die Konidienzellen des Mehлтаupilzes, *Sphaerotheca fuliginosa*, enthalten ausser einer Anzahl von Fibrosinkörpern und Volutinkörnern auch viele rundliche Vakuolen, 3-5  $\mu$  im Durchmesser. Die letzteren sind *in vivo* durch die saueren Farbstoffe, wie Eosin kaum, doch durch die basischen oder neutralen gut färbbar, besonders durch Neutralrot. Wenn man dem Präparat das letztere hinzufügt, so erscheinen zuerst in jeder Vakuole 1-mehrere rötlichviolette winzigkleine kugelige Tropfen, welche unter BROWNScher Bewegung sich zueinander verschmelzen und wachsen beträchtlich durch die Aufnahme des benachbarten Zellsaftes (tropfige Entmischung). Weiter nach etwas mehr als zehn Minuten färbt sich der ganze Inhalt der Vakuole dünnorange. Mittels dieser Vitalfärbungsmethode kann man beurteilen, ob die Zelle, welche diese Vakuole enthält, lebend ist oder nicht, weil im letzteren Fall keine Entmischung stattfinden wird.

**17. Matériaux pour la flore des Urédinées de l'Île de Saghaline septentrionale.** Yoshio HASHIOKA. (Jour. Japan. Bot. **12**, 1936, 882-886).

Cet article contient le nom des échantillons des Urédinées, qui ont été récoltées chez le domaine russe de l'Île de Saghaline par feu Monsieur le Prof. Y. KUDO et quelques autres. Melampsoraceae: *Calyptospora* (1), *Melampsoridium* (1), *Melampsorella* (1), *Pucciniastrum* (3), *Thekospora* (1), *Melampsora* (2), *Chrysomyxa* (2), *Cronartium* (1), *Coleosporium* (2); Pucciniaceae: *Phragmidium* (2), *Uromyces* (3), *Puccinia* (10).

Les noms des plantes-hôtes sont donnés pour chaque espèce.

**18. Excavatia, a noteworthy genus from Bonin Island.** (Japanese). Sumihiko HATUSIMA. (Jour. Japan. Bot. **12**, 1936, 484-485, 1 text-fig.).

An evergreen tree belonging to the Apocynaceae from the Bonin Island was ranked formerly among the genus *Ochrosia* or *Bleekeria*. The author's study has convinced him of the fact that it should properly belong to the genus *Excavatia*. Hitherto only its three species were known, and all from the monsoon region. The species under question should be named *Ex. hexandra* (KOIDZ.) HATUSIMA comb. nov.

**19. Contributiones ad dendrologiam nipponiae australis (II).** (With Japan. résumé). Sumihiko HATUSIMA. (Jour. Japan. Bot. **12**, 1936, 873-881).

The following new species are described among others: *Ilex kiusiana*, *Helwingia liukiensis*, *Frangula austro-sinensis*.

**20. Nächtliche Atmung der Laubblätter an ihren natürlichen Standorten.** (Japanisch). Keinosuke HIRAMATSU. (Oekolog. Studien **2**, 1936, 277-284, 5 Textabb.).

Die Blätter oder die kleinen Zweige von drei Arten Pflanzen, d.h. *Sorbus Aucuparia*, *Gaultheria adenothrix* und *Ilex Sagerokii*, wurden in Hinsicht auf ihre nächtliche Atmung untersucht, und zwar durch das Ermessen der pro Stunde aus 100 cm<sup>2</sup> Laubfläche ausgeschiedenen CO<sub>2</sub>-Menge in mg; das Ermessen wurde jedes Mal zwischen 7 Uhr Nachmittag und 4½ Uhr Vormittag des nächsten Tages ausgeführt. Dabei hat man im ganzen drei Typen unterscheiden können. Beim ersten Typ (*Sorbus*) ist die Kurve, welche die ausgeschiedene CO<sub>2</sub>-Menge zeigt, in ihrem mittleren Teile, z.B. von 11 Uhr 20 Min. Nachmittag bis zu 0 Uhr 20 Min. Vormittag, stark gesenkt, was zeigt, dass hier die nächtliche Atmung während der Mitternacht bedeutend schwächer

ist als vor und nach derselben. Dabei ist zu bemerken, dass diese Kurve vom Beginn des Ermessens bis zur Mitternacht (11 Uhr 20 Min.) ganz gleicherweise wie die Temperaturkurve verläuft, aber nachher gar nicht. Beim zweiten Typ (*Sorbus*, *Gaultheria*, *Ilex*) dagegen zeigt dieselbe Kurve bei der Mitternacht eine Erhebung. Der Verlauf dieser Kurve ist ganz verschieden von dem der Temperaturkurve, obgleich an gewissen Teilen er mit demselben der Kurve des Feuchtigkeitsgrades übereinstimmt. Die zwei obigen Beispiele lehren uns, dass die Intensität der nächtlichen Atmung, wenn sie etwas durch die Temperatur oder Feuchtigkeit des Wohnortes beeinflusst werden kann, doch sie hauptsächlich durch die innewohnende in ihrem Wesen noch unbekannte Kraft reguliert werden wird.

Ausserdem hat der Verf, wenn sehr selten, einige Beispiele aufgefunden, wobei der Kurvenverlauf der nächtlichen Atmung völlig mit demselben des Temperatur- oder Feuchtigkeitsgrades übereinstimmt (Typ III). Noch weiter hat er einen Fall beobachtet, wobei die  $\text{CO}_2$ -Ausscheidung eine Stunde lang völlig sistiert worden ist.

**21. Notes on Japanese rust fungi (VIII).** (With Japan. résumé). Naohide HIRATSUKA. (Jour. Japan. Bot. **12**, 1936, 673-678, 3 text-figs.).

**22. Kuehneola of Japan.** (With Japan. résumé). Naohide HIRATSUKA. (Jour. Japan. Bot. **12**, 1936, 809-815, 1 fig-group).

4 Japanese species of *Kuehneola* are enumerated with the analytical key for their identification.

**23. Gymnosporangium of Japan I-V.** (With Japanese résumé). Naohide HIRATSUKA. (Bot. Mag. Tôkyô **50**, 1936, 481-488, 549-555, 556, 593-599, 661-668, 669; ibid **51**, 1937, 1-31, altogether 3 pls.).

A number of Japanese species of *Gymnosporangium* are enumerated with their habitat and distribution. The results of the author's inoculation experiments are also included. The list of cited literature occupies 5 pages.

**24. A monograph of the Pucciniastreae.** Naohide HIRATSUKA. Tottori, 1936, 377 pp and 11 pls.

After the introduction comes the general part, where the general characters of the Pucciniastreae, their classification, host plants, phylogeny, geographical distribution are discussed. The geographical distribution of the Japanese species forms a special chapter. The great bulk of the book (p. 48-328) is the special part, where the enumeration and description of all known species with the key for their determination are contained. This is followed by the extensive citation of literature (337-359), fungus index (360-365), and host index (366-374). *Uredinopsis daisanensis*, *U. Hashikui*, *Milesina Kameiana*, *M. polypodii-superficialis*, *M. arisanensis*, *Pucciniastrium Actinidia* are the new species of the author.

**25. On the germination of pollen obtained from mosaic tobacco plants.** Shigekatsu HIRAYAMA. (Proc. Imp. Acad. **12**, 1936, 202-204).

According to KOSTOFF the female sterility of tobacco plants affected by mosaic virus is due to the low germination of pollen grains caused by the abundant occurrence of abortive ones (40-50%). The author has studied in this respect healthy as well as diseased plants, and found that such an enormous quantity of abortive pollen is never seen, its amount being at most a little more than 11%, both in healthy and diseased plants. Furthermore, the inoculation experiments with pollen from diseased plants has given him positive results.

**26. Cytological study of tobacco mosaics II.** (Japanese with English résumé). Shigekatsu HIRAYAMA and Akira YUASA. (Ann. Phytopathol. Soc. Japan **6**, 1936, 119-128, 9 text-figures).

The cytological study of the tobacco plant affected by mosaic virus has shown that the X-bodies are found in the pollen mother-cells and tetrads. It may however be added that they are seen in the former simply during their resting stage, but not during the reduction division.

When the expressed juice of diseased plants which was boiled for about 15 min. is used as the inoculum no symptoms of disease appear in the inoculated plants, nor can we observe the X-bodies, which proves that the disease as well as the formation of the X-bodies is due to the action of active virus.

**27. Nuntia ad floram japonicam XXVI-XXX.** (With Japan. résumé). Masaji HONDA. (Bot. Mag. Tôkyô **50**, 1936, 389-392, 412-413, 435-437, 473-474, 457-572, 587-588, 608-609, 648, 668-670, 696-697, 2 text-figs.).

The following are new species: *Elymus tsukushiensis*, *Potamogeton miyazimensis*, *Clinelymus yubarikakensis*, *Calamagrostis kai-alpina*, *Amethystanthus Manabeanus*, *Adenophora puerallis*, Besides a certain number of new varieties and combinations are contained.

**28. A new species of Swertia.** (With Japanese résumé). Masaji HONDA and Misao TATEWAKI. (Trans. Sapporo Nat. Hist. Soc. **14**, 1936, 192).

Description of a new species *Swertia chrysantha*.

**29. Contributions to the bryological flora of Eastern Asia (V).** (With Japan. résumé). Yoshiwo HORIKAWA. (Jour. Japan. Bot. **12**, 1936, 666-673, 2 text-figs.).

The following new species are described among others: *Frullania curiosissima*, *Catharinaea speciosa*.

**30. Symbolae florae bryophytæ Orientali-Asiæ et Micronesiæ IX-X.** (With Japan. résumé). Yoshiwo HORIKAWA. (Bot. Mag. Tôkyô **50**, 1936, 380-385, 409-410, 556-561, 585-586, altogether 6 text-figs.).

New species: *Microlejeunea ponapensis*, *Orthomnium curiosissimum*, *Boninoleptocolea drepanolejeuneoides*, *Catharinaea gigantea*, *C. yakushimensis*.

**31. Vitality of spores of stripe-disease fungus on barley which have passed through the alimentary canal of cattle.** (Japanese). Suehiko IKATA, Iitirô KASAI, Masazi YOSIDA, and Isao YOKOTA. (Agric. and Hort. **11**, 1936, 2164-2174).

The culms, grains, etc. bearing conidia of *Cephalosporium gramineum* NISIKADO et IKATA (stripe-disease of barley) were given to cows, hens, etc. Spores contained in their excrements were tested for the vitality. It was ascertained that not only do such spores retain their original shape as well as vitality perfectly, and can be made the object of artificial culture, but also they are quite unchanged in respect to their pathogenicity. One of the reasons of such remarkable vitality is that they are quite indifferent towards the state of hydrogen ion concentration, so that the acidity of the alimentary canal is not able to digest them.

**32. Studies in the Geoglossaceae of Japan III. The genus Cudonia.** Sanshi IMAI. (Bot. Mag. Tôkyô **50**, 1936, 671-676).

Two new sections, viz. *Eucudonia* and *Pachycudonia* are established. The former



contains 3 species, viz. *Cudonia circinans*, *helvelloides* and *japonica*; the latter contains 1 species, *C. constrictospora*.

Besides some little known species are noticed.

**33. Sports of perpetual carnations.** Yoshitaka IMAI. (Jour. Coll. Agric., Tokyo Imp. Univ. **14**, 1936, 1-10, 1 col. pl.).

Various kinds of sports of "Perpetual Carnations" (*Dianthus Caryophyllus*) concerning the flower colour and size as well as the foliage are enumerated. The author thinks that all such sports may be due perhaps to the multiple series of mutable alleles or to somatic rearrangement of tissues in periclinal stocks.

**34. Further studies in the duplication of petals in *Prunus Mume*.** Yoshitaka IMAI and Benso KANNA. (Jour. Coll. Agric., Tokyo Imp. Univ. **14**, 1936, 53-70, 5 text-figs. and 21 tables).

Through the study of the mode of petal duplication in 27 garden varieties of *Prunus Mume* the authors could confirm what was formerly stated by IMAI (cf. Japan. Jour. Bot. **8**, (7), No. 24). According as the duplication of petals is slight or considerable, either petaloidy or petalomany may be regarded as its chief cause respectively. Both processes act equally in the increase and decrease of stamen number.

**35. Vittarieae japonicae (II).** (Japanese and Latin). Hiroshi ITO. (Jour. Japan. Bot. **12**, 1936, 459-476, 3 text-figs.-group).

This part refers to Tribus II, Vittariinae containing the genera *Ananthocorus* and *Vittaria*, as well as Tribus III Anthrophyinae containing the genera *Anetium*, *Hecistopteris* and *Antrophyum*. Each species contained in all these genera is enumerated or described, sometimes with the key for the determination. *Vittaria bonincola* is a new species.

**36. Fresh water Centricae in Japan VI.** (Japanese and English), Yasumi IWAHASHI. (Jour. Japan. Bot. **12**, 1936, 562-567, 6 text-figs.).

**37. Chromosome chimaera formed by the decapitation-callus method in a plant of the genus *Solanum*.** (Japanese). Fuyuwo KAGAWA. (Proc. Crop Sc. Soc. Japan **8**, 1936, 431-438).

In a plant of the genus *Solanum* which is to be placed at least very near to *S. gracile* the author has counted 12 chromosomes in its PMC. From this plant he has got by usual decapitation method two shoots, each of which contains 24 chromosomes (n). Later the author has got from the latter several shoots containing either 12 or 24 chromosomes. Below will be cited an instance in later generation which the author takes for that of the chromosome chimaera. From a 24-chromosomic plant he has obtained one shoot containing also 24 chromosomes. This shoot was cultivated as a cutting, and he has obtained from it 7 plants, of which 5 contained 24 chromosomes like the parent, while 2 only 12. On the basis of this and other similar observations the author comes to the conclusion that in the parent plant from which such offspring containing different chromosome number are derived he has to deal with the case of chromosome chimaera, i.e. such parent shoot is not composed simply of tetraploid cells, but of both tetra- and diploid ones.

**38. On the osmo-regulation of root-hairs.** (Japanese with English résumé). Hisakazu KANAMORI. (Bot. Mag. Tôkyô **50**, 1936, 681-687, 5 text-figs.).



The plasmolytic experiments were done on the root-hairs which are developed on the seedlings of *Brassica chinensis* under 20°C and 100% relative humidity.

When the concentration of the surrounding solution wherein the root-hairs are growing varies the incipient plasmolytic concentration of root-hairs was found to vary proportionally to that concentration. Thus to cite a few instances, when the concentration of the surrounding sugar solution is 0.01, 0.1, 0.3 mol., etc. the osmotic value of root-hair cells was found to be 0.25, 0.30, 0.43 mol. etc. respectively. When the root-hairs which are developed in saturated damp air are transferred into a hypotonic solution under a certain limit plasmoptysis sets in, and then it was observed that the presence of Ca in that solution protects them against this process, while that of K rather favours its occurrence.

When the root-hairs which are growing in damp air (aerial root-hairs) are immersed in a sugar solution they will regulate their osmotic value so as to make it proportional to that of the latter, though some abnormal forms may develop. When aerial root-hairs are put directly into water their injury is the necessary result, which however can be avoided, if they are put at first in 0.5 sugar solution and then gradually the concentration will be reduced till zero.

**39. New or noteworthy trees from Micronesia IX-XVIII.** (With Japan. résumé). Ryôzô KANEHIRA. (Bot. Mag. Tôkyô **49**, 1935, 60-68, 98-99, 103-114, 175-176, 185-195, 257-258, 271-279, 338-339, 352-358, 406-407, 425-431, 476-477, 525-532, 567-568; *ibid* **50**, 1936, 520-525, 534-535, 541-549, 583-584, 599-607, 646-647, altogether 59 text-figs.).

The following new species are described with illustrations, of which those belonging to the genus *Pandanus* are most prominent: *Pandanus divergens*, *cylicus*, *dilatatus*, *erythrophloeus*, *Hosinoi*, *jaluitensis*, *korrensis*, *kusaiensis*, *Okamotoi*, *Volkenii*, *pelilensis*, *laticaliculatus*, *Utiyamai*, *trukensisbrachypodus*, *rhombocarpus*, *macrocephalus*, *rotundatus*, *enchabiensis*, *duriocarpoides*, *Eyesyes*, *insularis*, *Lakatwa*, *obliquus*, *tomitensis*, *saipanensis*, *Hosokawai*, *charanceanus*, *Yamagutii*, *Syozoi*, *Frey-cinetia carolinensis*, *almonoguiensis*, *Palaoea* (gen. nov. Sapindaceae) *jalcata*, *Ventilago Nisidai*, *Amaracarpus kusaiensis*, *Trukia* (gen. nov. Rubiaceae) *megacarpus*, *Pterocarpus carolinensis*, *Pipturus micronesicus*, *Ervatamia rotensis*, *Anacolosia gluchidiiformis*.

**40. On the Micronesian *Pandanus* I-II.** (Japanese). Ryôzô KANEHIRA. (Jour. Japan. Bot. **12**, 1936, 495-501, 545-554, altogether 21 text-figs.).

After the foreword the author states in order the history of the investigation of *Pandanus*, its practical use, its species in Japan proper as well as Micronesia. The Micronesian forms of *Pandanus* hitherto recognized amount to 38 species and 7 varieties, of which the following species recently collected are described as new and illustrated: *P. Syozoi*, *saipanensis* and *charanceanus*.

**41. Palmae micronesiae II-III.** (Japanese with Latin diagnoses). Ryôzô KANEHIRA. (Jour. Japan. Bot. **12**, 1936, 634-640, 729-734, 5 text-figs.).

Among others *Pinanga micronesica*, sp. nov., *Ponapea Hosinoi*, and *P. palauensis* are described with illustrations.

**42. Riesenpollenkörner bei den F<sub>1</sub>-Bastarden *Aegilops squarrosa* × *Haynaldia villosa* und *Aegilops caudata* × *Aegilops speltoides*.** Hitoshi KIHARA und F. LILIENTHAL. (Japan. Jour. Gen. **12**, 1936, 239-256, 9 Textabb.).

Die 1-5-kernigen Riesenpollenkörner mit 2 Keimporen, welche die Verf. bei *Aegilops squarrosa* × *Haynaldia villosa* F<sub>1</sub> beobachteten, sind dadurch ausgebildet, dass 1. nach der ersten Reifungsteilung gar keine Zellwand oder sie sehr mangelhaft produziert ist, und 2. die rudimentäre und stark verspätete, zweite Teilung sofort rückgängig gemacht wird. Die Riesenpollenkörner mit 1-4 Keimporen bei *Aegilops caudata* × *Aegilops speltoides* F<sub>1</sub> sind die Folge der Regression der entweder I. oder II. Teilung oder von beiden. Solche Pollenkörner mögen teilweise tetraploid sein, und nach den experimentellen Studien der Verf. sind sie fähig, selbst oder *A. speltoides* zu befruchten.

**43. Symbolae iteologicae II.** Arika KIMURA. (Sc. Rpts., Tôhoku Imp. Univ., 4th Ser. **11**, 1936, 243-252, 2 pls. and 3 text-figs.).

Two new hybrids, × *Salix Turumatii* hybr. nov. and × *Toisochosenia* gen. hybr. nov. are described among others.

**44. Takasagoya, a new genus of Hypericaceae.** (With Japan. résumé). Yojiro KIMURA. (Bot. Mag. Tôkyô **50**, 1936, 497-503, 4 text-figs., 532-533).

A plant belonging to the Hypericaceae, hitherto known as *Hypericum formosanarum* MAX. was excluded by the author from the genus *Hypericum* and included among a new one *Takasagoya*. The latter contains besides *T. formosanarum* comb. nov. six other species, all of which are comb. nov.

**45. Les Aster du Japon ; leur classification et leur distribution I-III.** (En japonais avec les diagnoses latines). Sirô KITAMURA. (Jour. Japan. Bot. **12**, 1936, 529-536, 640-652, 721-729).

Une monographie du genre *Aster*, dont la classification se fonde principalement sur celle d'Asa GRAY. Quelques séries, variétés et combinaisons nouvelles ont été établies par l'auteur. *Aster kantoensis* est une espèce nouvelle et décrite.

**46. Zur SCHIMPER-MEYERSchen Theorie der Vermehrung der Chloroplasten.** Kogane KIYOHARA. (Jour. Fac. Sc., Imperial University, Tokyo, Sec. III, **4**, 1935, 399-465, 7 Taf. und 31 Textabb.).

Diese Abhandlung ist in der Hauptsache die Erweiterung der schon früher vom Verf. veröffentlichten Tatsachen (vgl. Japan. Jour. Bot. **3**, (31), Nr. 94 und (87), Nr. 259).

Durch die Messung der Chloroplasten an 262 Blütenpflanzenarten konnte der Verf. feststellen, dass die Grösse derselben fast konstant beträgt (5 $\mu$ ). Sie sind kugelig und mehr oder minder scheibenförmig. Durch die Einwirkung von Silbernitrat oder Osmiumsäure ist jeder Chloroplast an der Peripherie schwarzgefärbt und der Zentralteil bleibt farblos, sodass er ringförmig erscheinen wird, was sowohl im alten wie sehr jungen Zustande gleich zu beobachten ist. Die Substanz, welche Silbernitrat oder Osmiumsäure reduziert, ist weder Fett noch Lipoid, obgleich ihre exakte Natur noch unbekannt ist. Die Stärkekörner werden an der Peripherie der Zentralgebilde der Chloroplasten ausgebildet. Ihre rundliche Gestalt bei *Hydrilla verticillata* usw. wird durch das CARNOYSche Tripel-Gemisch und besonders durch das KOLATCHEVSChe Reagenz naturgetreu konserviert. Wenn solche Reagentien zum Nachweis der Chloroplasten gebraucht werden, kann man leicht nachweisen, dass in sehr jungen Zellen des Meristems die rundlichen Chloroplasten schon vertreten sind. Dagegen wenn man bei der Fixierung das REGAUDSche oder das CHAMPYSche Gemisch gebrauchen wird, sieht man feinfädige Körper, welche in ihrer Gestalt an die

Chondriosomen erinnern, und welche nichts anderes sind als die durch solche Reagentien deformierten Chloroplasten. Aus allem konnte der Verf. zum ebensolchen Schluss wie früher kommen, dass keine Chondriosomen in den pflanzlichen Zellen vorhanden sind. Auch hat er seinen früheren Schluss bestätigt, dass die SCHIMPER-MEYERSche Ansicht betreffend die Vermehrung der Chloroplasten durch Teilung zu Recht besteht.

Weiter hat der Verf. das Vorkommen von Stärkekörnchen in den Pollenkörnern, Pollenschläuchen, Synergiden, Eizellen und vierzelligen Embryonen nachweisen können.

**47. Bambusaceae novae japonicae III.** Geniti KOIDZUMI. (Acta Phytotax. et Geobot. **5**, 1936, 198-203).

The following are new species: *Arundinaria kesenensis*, *Sasa adstricta*, *angustifolia*, *iwakiensis*, *kesenensis*, *numbuana*, *muricata*, *Ohdana*, *Ohwii*, *sacrosancta*, *Tobazonoana*, *yettuiensis*, *yutakana*.

**48. Taraxacum novum japonicum IV-VI.** (With Japan. résumé). Hideo KOIDZUMI. (Jour. Japan. Bot. **12**, 1936, 618-634. 712-720, 816-822).

11 new species and some new varieties, forms and combinations, are described.

**49. On the use of the "powder method" in studying water requirement.** (Japanese with English résumé). Riichiro KÔKETSU and Katsuo NAGASAWA. (Bul. Sci. Fak. Terk. Kjušu Imp. Univ. **7**, 1936, 211-227).

The water requirement at the early stage of development of rice plants cultivated under different conditions of soil moisture, soil fertilizer and sunlight was studied; and its values were given not only by the amount of water transpired or absorbed per unit weight of dry matter, but also by the amount per unit volume of dry matter or dried tissue powder, and further by that per unit weight of ash.

The value of water requirement and the degree of the variation of its values differed mutually, according to the difference of the method of estimating water requirement. As a matter of course, the water requirement or the so-called efficiency of transpiration, estimated by a given method, has its own special meaning. When, however, the water requirement is judged from the standpoint of the amount of water used for producing the unit amount of dry matter of plants, which has to mean the unit size of the plant in a natural sense, it was ascertained that the tissue powder volume method or the "powder method" brings better or more reasonable results as expected, than the ordinary dry weight method.

Author.

**50. The endosperm formation in *Cryptomeria japonica*.** Harunobu KURIHARA. (Sc. Rpts., Tôhoku Imp. Univ. 4th Ser. **11**, 1936, 185-189, 22 text-figs.).

The results of the author's cytological study on the gametophyte of *Cryptomeria japonica* differ from those of LAWSON (1904) in several respects. According to the present author only one megaspore mother-cell is formed in the nucellus instead of several as stated by LAWSON. Out of two cells formed after the reduction division the lower one undergoes the second division, the upper one disorganizing afterwards, so also the tapetal cells (not present according to LAWSON). The lower cell formed by the second division above indicated turns into the female gametophyte. The manner of endosperm formation shows nothing unusual in contrast to the statement of LAWSON.

**51. Beobachtungen über die Chloroplastenteilung bei einigen Blütenpflanzen.** Seikan KUSUNOKI und Yoshio KAWASAKI. (Cytologia **7**, 1936, 530-534, 7 Textabb.).

Durch die Beobachtung lebender Zellen von *Utricularia vulgaris* und *Conandron ramondoides* konnten die Verf. die Angabe Kiyoharas im ganzen bestätigen, wonach die Teilung der Chloroplasten in der Nacht vollendet wird. Bei diesem Vorgang werden die anfangs rundlichen Chloroplasten allmählich kokonförmig und dann hantelförmig durch die Ausbildung der Furche, um schliesslich durch die fortschreitende Vertiefung derselben sich zu zwei Töchterchloroplasten auszutrennen. Der Vorgang bis zum Hantelförmigwerden vollzieht sich bei *Conandron* im allgemeinen untertags und dauert bis zum Abend, doch die Teilung selbst geht in der Nacht vor sich.

**52. Karyologische und genetische Studien an *Fragaria* III. Geschlechtsverhältnisse in den  $F_2$ - und weiteren Folgegenerationen des Bastards zwischen der getrenntgeschlechtigen *F. elatior* und der zwittrigen *F. nipponica*.** F. A. LILIENFELD. (Mem. Coll. Agric. Kyoto Imp. Univ. No. 34, 1936, 58 S. und 21 Textabb.).

Durch die Kreuzung, getrenntgeschlechtige hexaploide ( $6n = 42$ ) *Fragaria elatior*  $\times$  zwittrige diploide ( $2n = 14$ ) *F. nipponica* sind die  $B_1$ -Bastarde (*F. elnipponica*) entstanden, welche getrenntgeschlechtig und tetraploid ( $4n = 28$ ) waren. In ihrer  $F_1$ -Generation wurden eine Anzahl von Zwittern ausgespalten, deren Fertilitätsgrad individuell höchst verschiedenartig war. Bei dieser  $F_1$ -Aufspaltung erwartet man  $\varphi : \sigma : \varnothing$  zu  $2:1:1$ , dennoch war die Zahl von zwei ersteren Nachkommen bedeutend niedriger und dieselbe der Männchen bedeutend höher als theoretisch zu erwarten war. Die Ursache des in Rede stehenden beträchtlichen Defizits der Weibchen und Zwitter und des beträchtlichen Ueberschusses der Männchen wurden auf gewisse Blütenverhältnisse in  $F_1$  zurückgeführt, deren ausführliche Erörterung hier ausbleiben muss. In der  $F_2$ -Generation war die relative Zahl von  $\varphi : \sigma : \varnothing$  viel näher der Erwartung gestanden als in  $F_1$ , was dem besseren Zustande der  $F_2$ -Pflanzen zur Blütezeit zu verdanken sein dürfte. In  $F_2$  erwartet man das Vorhandensein von zweierlei Arten Weibchen betreffend ihren Geschlechtsrealisatoren, nämlich diejenigen mit einem  $\gamma$ -Realisator und diejenigen mit den beiden  $\alpha$  und  $\gamma$  ( $\alpha$  und  $\gamma$  im bekannten CORRENSschen Sinne). Die  $F_1$ -Experimente haben das Vorhandensein der ersten Art Weibchen sichergestellt, und die Möglichkeit des Vorhandenseins der zweiten bewiesen.

Die Resultate der  $F_2$ -Versuche wurden auch benutzt, um die genotypische Natur von Männchen bezüglich ihrem Geschlechtsrealisator nachzuweisen, d.h. ob irgend ein Männchen mit einem oder zwei  $\alpha$ -Realisatoren oder mit keinem versehen ist. Experimentell wurde dasselbe mit einem  $\alpha$  sichergestellt, aber kein anderes.

Bei einem  $F_1$ -Männchen wurde die merkwürdige Tatsache beobachtet, dass es seit dem zweiten Blühjahre vollzwittrig geworden ist und seither sich immer so verhielt, was auf das Zurückmutieren des  $\alpha$ -Realisators zum ursprünglichen (zwittrigen) Zustand zurückzuführen sein mag.

Die Kreuzung, *F. elatior*  $\times F_1$  und ihre reziproke gaben pentaploide Nachkommen, auch sind aus der Kreuzung *F. nipponica*  $\times F_1$  und ihrer reziproken triploide Nachkommen entstanden. Ausführliches darüber kann hier nicht referiert werden.

Eine wichtige Annahme, welche auf die Zahlenverhältnisse 1:1 von beiden Geschlechtern bei *F. elatior* gegründet ist, lautet wie folgt, nämlich: bei derselben sollen die Realisatoren  $\alpha$  und  $\gamma$  auf einem unter den darin enthaltenen 6 Genompaaren gelagert werden.

Für weiteres, und zwar besonders für theoretische Diskussionen sei auf das Original verwiesen.

**53. The effect of abnormal temperature upon the pollen formation of *Petunia*.** Hideo MATSUDA. (Jour. Coll. Agric., Tokyo Imp. Univ. 14, 1936, 71-92, 33 text-figs.).



A diploid small variety and a tetraploid plant of the giant variety of *Petunia hybrida* L. were the materials of the author's experimental cytological studies. Low temperature ranging from 0–12°C exerts no influence at all upon the meiosis of pollen mother-cell. Above 37°C the irregularities of the meiotic division begin to appear, and especially when the temperature ascends from 4°C to 42°C during this process, a considerable number of viable large pollen grains are produced. The treatment with low temperature before that with high one leads to the exaggeration of the effect of the latter. The irregularities of the meiotic division are among others the non-conjunction of chromosomes in the first metaphase, poor development of spindle fibres, diffuse arrangement of chromosomes in the first and second metaphase, etc.

**54. Genetische Studien über die pentaploiden Weizenbastarde I. Vererbung der von den Chromosomenzahlen abhängigen morphologischen Eigenschaften bei der Verbindung *Triticum polonicum* × *T. spelta*. (Mit japan. Zfg.).-II. Vererbung der von den Chromosomenzahlen unabhängigen morphologischen Eigenschaften bei der Verbindung *Triticum polonicum* × *T. spelta*. (Mit japan. Zfg.).** Seiji MATSUMURA. (Japan. Jour. Gen. **12**, 1936, 121–136, 1 Taf.; ibid. 289–306, 3 Textabb.).

Früher (vgl. Japan. Journ. Bot. **8**, 66–83) hat der Verf. an den pentaploiden Bastarden *Triticum polonicum* × *T. spelta* gezeigt, dass die Vererbung gewisser Merkmale, nämlich Halmmarkigkeit und Ährendichte von den Chromosomenzahlen jedes Individuums abhängig ist und demnach der Erbfaktor für das erstere Merkmal sowie die Erbfaktoren (kumulativ) für das letztere zum Dinkelgenom D gehören müssen. Die obigen Ergebnisse sind auf die Resultate der Untersuchungen von F<sub>2</sub>-Nachkommen gegründet worden. Diesmal hat der Verf. die Rückkreuzungsexperimente (Kreuzung zwischen F<sub>1</sub> und *polonicum* oder *spelta*) ausgeführt und seine frühere Ergebnisse völlig bestätigen können.

Die weiteren Untersuchungen an das gleiche Material sowie F<sub>2</sub>-Nachkommen haben gezeigt, dass gewisse andere Merkmale, nämlich, Begrannung, Knoten- und Spelzenbehaarung und Spelzenlänge ganz unabhängig von den Chromosomenzahlen jedes Individuums vererbt werden und demgemäss die betreffenden Erbfaktoren in einem der Faktorenpaare AA oder BB gehören müssen. Alle diese Merkmale spalten sich in monohybrider Weise auf, obgleich diejenigen für die Begrannung und Knotenbehaarung gekoppelt sind, und zwar mit dem Austauschwert ±28,5%. Es wurde weiter festgestellt, dass der Faktorf P für Spelzenlänge die Entwicklung der Begrannung und Behaarung zu einem gewissen Grade hemmen wird.

**55. On the relation of chromosomes to nucleoli.** (Japanese with English résumé). Hajime MATSUURA. (Bot. & Zool. **3**, 1936, 1589–1594, 2 fig.-groups).

The hypothesis of HEITZ concerning the relation between the SAT-chromosome and the formation of nucleoli was verified in some Liliaceae. In one species of *Allium* and two of *Polygonatum* the intimate connection of the achromatic part of the SAT-chromosome with the nucleolus was ascertained. In one species of *Lilium* as well as the diploid and triploid species of *Fritillaria kamschaticum* the numerical parallelism between the nucleoli and the SAT-chromosomes was observed. Finally in one *Trillium*, where no SAT-chromosome is present, the connection between the distal part of a certain chromosome and the nucleolus was seen.

**56. Plant fossils from the Stegodon Beds, and the Elephas Beds near Akashi.** Shigeru MIKI. (Japan. Jour. Bot. **8**, 1937, 303–341, 2 pls. and 11 text-figs.).



**57. Contributions to the flora of Northern Japan VII-IX.** Kingo MIYABE and Misao TATEWAKI. (Trans. Sapporo Nat. Hist. Soc. **14**, 1935, 69-86, 181-192, 255-270, altogether 12 text-figs.).

The following new species are described among others: *Aconitum Tatewakii*, *Callianthemum sachalinense*, *Oxytropis shokabetsuensis*, *O. sachalinensis*, *Plantago Togashii*, *Adenophora uryuensis*, *Silene Kawashimai*, *Cerastium orochonorum*, *Trillium Hagae*, *Calanthe okushirensis*, *Cardamine chiriensis*, *Saussurea Kitamurai*.

**58. Über die Variabilität der Kakitsubata (*Iris laevigata* FISCH. et MEY.) in ihrer Assoziationen.** Manabu MIYOSHI. (Proc. Imp. Acad. **12**, 1936, 258-260), 1 Text-fig.).

Der Verf. fand in gewissen Örtlichkeiten Japans bald die Assoziationen von *Iris laevigata* mit violetten Blüten, bald dieselben mit nur weissen, und bald dieselben mit beiden weissen und violetten. Die folgenden neuen Formen und Varietäten von *Iris laevigata* sind erwähnt: f. *quadrumera*, f. *quinquemera*, var. *alba*, var. *albovariegata*.

**59. Über zwei merkwürdige Kirschen.** Manabu MIYOSHI. (Proc. Imp. Acad. **12**, 1936, 261).

Zwei neue Formen aus der Gattung *Prunus* sind beschrieben *P. mutabilis* f. *kongo* und *P. serrulata* f. *vezillifera*.

**60. A new species of *Rosa* (*Systylae*) from Yakushima.** (Chiefly in Latin). Yasuichi MOMIYAMA. (Jour. Japan. Bot. **12**, 1936, 578-579, 1 text-fig.).

*Rosa yakualpina* NAKAI et MOMIYAMA sp. nov. is described. Found in Mt. Yae-gatake in Isl. Yakushima, Southern Japan.

**61. The Styracaceae of Taiwan II.** Kunihiko MORI. (Jour. Japan. Bot. **12**, 1936, 476-484, 7 text-figs.).

4 species of *Styrax* and 1 var. are described in detail with illustrations.

**62. A description of *Symplocos taririkensis* sp. nov. from Taiwan.** (Japanese with Latin diagnosis). Kunihiko MORI. (Jour. Japan. Bot. **12**, 1936, 892-893, 2 text-figs.).

**63. On the chromosomes of Manchurian kaoling.** (Japanese with English résumé). Taninori MORI. (Japan. Jour. Gen. **12**, 1936, 146-150, 67 text-figs.).

61 culture varieties of Manchurian kaoling (*Sorghum vulgare* = *Andropogon Sorghum*) studied by the author agree in showing the chromosome number  $n = 10$ ,  $2n = 20$ . Meiosis goes on quite normally. All somatic chromosomes are constricted once at median or submedian part. The peculiar-shaped A-chromosomes of HUSKINS and SMITH are seen in some cases.

**64. Kulturversuche der Unkräuter V. Beziehung zwischen dem Wachstum und dem pH-Wert im jungen und ausgewachsenen Stadium der Pflanzen.-VI. Einfluss der Borsäure und des Mangans auf das Wachstum von Sumpf- und Wegeunkräuter.** (Japanisch). Keizi MORITA. (Oekolog. Studien **2**, 1936, 192-199).

Ad V. Die Wasserkulturversuche von *Senecio vulgaris* wurden ausgeführt. Im jungsten, 1,5-2.0 cm hohen Zustande dieses Unkrautes beträgt der optimale pH-Wert für sein Wachstum 4,0-6,0 während in seinem ausgewachsenen Stadium er 5,0-7,0 beträgt. Ausserhalb diesen Grenzen findet kein Wachstum mehr statt und schliesslich erfolgt das Absterben. Im Falle des zu niederen pH-Wertes wird das Wachstum der

Wurzel verhindert, während bei seinem zu hohen Wert die oberirdischen Teile chlorotisch werden, um schliesslich abzusterben.

Ad VI. Sowohl die Sumpfkunkräuter, wie *Alopecurus* und *Rotala*, als die Wegeunkräuter, wie *Cerastium*, *Vicia*, *Senecio*, wurden als Untersuchungsmaterialien benutzt. Die Versuche bestehen darin, dass eine kleine Menge der Borsäure oder des Mangans zu den Nährlösungen der Wasserkultur hinzugefügt wurden. Die Sumpfkunkräuter sind sehr empfindlich gegen die Wirkung der Borsäure, dagegen sehr widerstandsfähig gegen dieselbe des Mangans, ja sogar wird ihr Wachstum durch Hingabe von  $\frac{1}{2}$ – $\frac{1}{4}$  mM Mangans befördert.

Das Verhalten der Wegenunkräuter gegen Mangan bzw. Borsäure ist gerade umgekehrt wie bei den Sumpfkunkräutern. Bei Zugabe einer kleinen Menge Borsäure ( $\frac{1}{2}$ – $1/32$  mM) wird ihr Wachsen stark befördert, doch führt das Vorhandensein nur einer sehr kleinen Menge Mangans ( $\frac{1}{2}$ – $\frac{1}{4}$  mM) zu ihrem Absterben.

**65. Über die unfruchtbaren Sumpfreissippen.** (Japanisch). Kiyosi MORITA. (Proc. Crop Sc. Soc. Japan **8**, 1936, 373–384, 5 Textabb.).

Unter den vom Verf. gesammelten und studierten unfruchtbaren Sumpfreissippen hat er den Typ mit  $2n + 1$  bzw. mit  $2n + 4$  aufgefunden ( $n = 12$ ). Bei dem ersteren ist die Rate von sterilen Pollenkörnern sowie von parthenokarpischen Früchten höher als bei dem  $2n$ -Typ; die Aehre ist kürzer und ungefähr ihre Hälfte wird durch die Blattscheide bedeckt; es gibt dabei keine fertile Körner. Der  $2n + 1$ -Typ (trisomisch) kann natürlich nicht immer einheitlich sein und es mag theoretisch 12 verschiedene Sorten geben. Indem aber bei Reis alle Chromosomen äusserlich keine wesentliche Verschiedenheit bieten, konnte der Verf. zwischen zwei von ihm gesammelten Pflanzen dieses Typs keinen Unterschied machen, obgleich sie innerlich verschieden sein könnten. Gleiches kann man auch betreffs  $2n + 4$ -Typ sagen.

Schliesslich hat der Verf. die Ausbildung von  $2n + 1$ -Typ durch die "non-disjunction" Hypothese zu erklären versucht.

**66. Iconographia plantarum Asiae orientalis Vol. I, Nos. 3-4.** Edited by Takenoshin NAKAI. (Pls. XX–XXVII, p. 45–60, and Pls. XXVIII–XXXVI, p. 61–80, index of Japanese plant names). Tōkyō, Sept. and Dec. 1936.

Continuation of "Iconographia" reviewed in former Nos. of this Journal. The following plants are contained in these two Nos.: *Arisaema nanum*, *A. niveum*, *A. longilaminum*, *A. robustum*, *A. Thunbergii*, *A. Kishidai*, *A. tosaense*, *A. ovata*, *Juncus oligocephalus*, *Cephalanthera Shizuoi*, *Aconitum karafutense*, *Polystichum Lonchitis* var. *japonicum*, *Miscanthus intermedius*, *Hosta gracillima*, *Hypericum umbrosum*, *Primula tosanensis* f. *brachycarpa*, *Saussurea peipingensis*.

The publication of No. 4 above cited completes Vol. I.

**67. Liliaceous plants with exposed seeds.** (Japanese with Latin diagnoses). Takenoshin NAKAI. (Jour. Japan. Bot. **12**, 1936, 773–783, 3 text-figs.).

Among the Liliales certain plants are included, where since after the fertilization the ovary does not develop at all the growing ovules break out through the ovarian wall and form in the ripening stage seeds which appear just like berries. The species of the genera *Ophiopogon*, *Liriope*, *Peliosanthes* and *Sansiviera* are the instances of this sort. On account of this peculiarity all these genera are ranked under one subfamily Ophiopogoneae by some authors, while others include simply *Liriope* and *Ophiopogon* under the latter. The author proposes to rank *Liriope* and *Ophiopogon* under

one family Ophiopogonaceae, and to establish two new families Sansevieriaceae and Peliosanthaceae for the genera *Sansevieria* and *Peliosanthes* respectively.

**68. *Clematis fusca* TURCZANINOW and *Clematis ianthina* KOEHNE.** (Japanese, English and Latin). Takenoshin NAKAI. (Jour. Japan. Bot. **12**, 1936, 835-847, 3 text-figs.).

Our knowledge concerning *Clematis fusca* and *C. ianthina* is rather confused, and the author's study has shown that the whole matter should be as follows: *Clematis fusca* TURCZANINOW var. *kamtschatica* REGEL et TILING, var. *yezoensis* MIYABE, var. *ajanensis* REGEL et TILING, var. *glabricalyx* var. nov. NAKAI, var. *tomentosa* var. nov. NAKAI; *C. ianthina* KOEHNE, var. *mandshurica* (REGEL) NAKAI, comb. nov., f. *obtusifoliola* (O. KUNTZE) NAKAI comb. nov., var. *amurensis* (O. KUNTZE) NAKAI, comb. nov.

**69. Flora sylvatica koreana. Pars XXI.** (Japanese and English with Latin diagnoses). Takenoshin NAKAI. Publ. by The Forest Exp. Sta., Gov. Gen. Chosen (Corea), Keizyô (Seoul), Japan 1936 163 pp., 11 pls., 9 text-figs.).

This part contains the following families, viz. Aristolochiaceae, Lardizabalaceae, Berberidaceae, Pittosporaceae, Malvaceae, Empetraceae and Urticaceae. In this part not only are ligneous plants, but also herbaceous ones included. The description of the species of *Boehmeria* is due to Y. SATAKE, and that of *Asarum* to F. MAEKAWA. The following new classification is adopted:

Ordo Aristolochiales: Asaraceae, Sarumataceae, Aristolochiaceae. Ordo Rafflesiales: Apodanthaceae, Cytinaceae, Hydnoraceae, Metrastemonaceae, Rafflesiaceae.

Two new genera, *Asiasarum* MAEKAWA and *Japanasarum* NAKAI were established, which belong to Asaraceae.

The following plants are new: *Akebia micrantha*, *A. quinata* var. nov. *polypylla*, *Epimedium koreanum*, *Berberis koreana* var. nov. *ellipsoidea*, *Pittosporum denudatum*, *P. Makinoi*.

The distribution of plants belonging to the families treated of in this part in Corea is indicated with the help of the maps.

**70. Index florae jeholensis sive enumeratio plantarum vascularum in provincia Jehol sponte nascentium hucusque cognitarum.** Takenoshin NAKAI, Masaji HONDA, Yoshisuke SATAKE, and Masao KITAGAWA. (Report of the first scientific expedition to Manchoukuo under the leadership of Shigeyasu TOKUNAGA, June-October 1933, Sec. IV, Part III, 1636., 108 pp and 3 pls.).

All plants, pteridophytes and phanerogams, collected in Jehol during the expedition above cited are enumerated, 924 in all, beginning with the Polypodiaceae and ending with the Orchidaceae. The appendix contains "plantae novae vel minus cognitae ex Manshuria", of which the following are described: *Populus manshuricam*, *Salix bordensis*, *Pleuropterypyrum jeholense*, *Kochia albovillosa*, *Suaeda heteroptera*, *Aquilegia Yabeana*, *Hesperis oreophida*, *Astragalus otosemius*, *Myosotis bothriospermoides*, *Artemisia oxycephala*, *Ligularia sinica*, *Xanthium mongolicum*, *Cleistogenes andropogonoides*, *C. Kitagawai*, *C. striata*, *Diarrhena nekka-montana*, *Phragmitis jeholensis*, *Poa asubaphylla*, *Puccinellia jeholensis*, *Stipa avenoides*, *S. Kitagawai*, *S. Nakaii*, *Juncus jeholensis*, *J. pseudo-Krameri*.

**71. Chromosome numbers in some crops and wild angiosperms.** Goichi NAKAJIMA. (Japan. Jour. Gen. **12**, 1936, 211-218, 57 text-figs.).

The author's results of counting  $n$  or  $2n$  chromosome numbers in a great number of angiosperms are published in this article with illustrations.

**72. Preliminary note on the polyploidy in *Solanum nigrum* LINN.** (Japanese). Miyawo NAKAMURA. (Jour. Soc. Trop. Agric. **7**, 1935, 255-256, 2 text-figs.).

In Formosa there are two forms of *Solanum nigrum*, of which one is characterized especially by larger reproductive organs and thicker leaves than the other. In the pollen mother-cells of the latter 12 chromosomes are observed, and the meiosis goes on quite regularly. It is evidently the diploid form. In the other the author has found in PMC 36 chromosomes which appear frequently as tetra-, hexa- and also bivalents in the first metaphase, while bi- and trivalent chromosomes are often met with in the second. The pollen formation is quite normal, and gives rise to pollen of large size. The author takes the plant under discussion for an autohexaploid, and consequently thinks further that the haploid form of JØRGENSEN and the tetraploid of the latter author and WINKLER are the triploid and dodecaploid respectively.

**73. Relations of oxydase contents to the germination capacity of cotton seeds.** (Japanese). Sadawo NAKATOMI. (Proc. Crop Sc. Soc. Japan **8**, 1936, 341-348).

Comparative studies on the germination of seeds of cotton species, *Gossypium herbaceum*, *G. hirsutum* and *G. barbadense* have formerly led the author to the conclusion that the difference of velocity of this process in these three species depends among others on that of the peroxydase content therein, i.e. the greater the latter, the more rapid the process. Recently, however, the author has observed in *G. barbadense* the fact that notwithstanding the feeble action of peroxydase the germination of its seeds takes place considerably more rapidly than in *G. hirsutum*, though not more rapid than in *G. herbaceum*. Through the chemical studies the author has ascertained that though in *G. barbadense* the action of peroxydase is as feeble as in *G. hirsutum* that of oxydase is stronger than either in the latter or *G. herbaceum*, whence the rapidity of germination of its seeds.

Just the same may be said concerning the capacity of water absorption of seeds of the respective species.

The cross *hirsutum*  $\times$  *barbadense* was performed. Seeds of  $F_1$  generation lie between the two parents concerning the action of oxydase, and in  $F_2$  the monohybrid segregation of germination velocity was observed, proving that this character is of hereditary nature.

**74. Two new marine algae from the Japan Sea.** (Japanese with English résumé). Seiichi NARITA. (Bot. Mag. Tōkyō **50**, 1936, 386-389, 410-412, 3 text-figs.).

Description of two new algae, *Castagnea Ikomae* and *Helminthora nipponica*.

**75. On the smut disease of *Sagittaria trifolia* L. var. *sinensis* MAKINO caused by *Doassansiopsis Horiانا* (P. HENN).** Yosikazu NISIKADO and Hiroyoshi MATSUMOTO. (Ber. ÔHARA Inst. landw. Forsch. **7**, 1936, 415-427, 5 pls.).

*Sagittaria trifolia* var. *sinensis* which is widely cultivated in Japan on account of its edible corms is often invaded by a smut fungus, *Doassansiopsis Horiانا*. When the aerial part is attacked and killed, the underground edible corms are much retarded in their development. In the leaf-lesions of the plant caused by this fungus dark-coloured elliptical ovoid or spherical bodies are formed in the parenchyma; they are the sori or spore-groups and called spore-balls.



The authors have performed the culture of this fungus. It may thrive in various nutrient media, of which potato-sugar-agar was the best one. Optimum temperature for the germination of spores and mycelial growth  $\pm 30^{\circ}\text{C}$ , minimum  $10^{\circ}$ , maximum  $35-37^{\circ}$ .

Inoculation experiments on young parts of leaves which are wounded have given positive results.

**76. The application of post-harvest pollination in the hybridization of rice-plant.** Yakichi NOGUCHI. (Japan. Jour. Gen. **12**, 1936, 324-326, 3 text-figs.).

Post-harvest pollination, i.e. the emasculation and pollination on the culm removed away from the plant was executed in barley by an American author with some success. The present author has performed the same procedure on the rice-plant, and got some seeds which are able to germinate.

**77. Plantae novae japonicae III.** (With Japanese résumé). Jisaburo OHWI. (Jour. Japan. Bot. **12**, 1936, 652-665).

The following new species are described among others: *Andropogon taiwanensis*, *Microstegium boreale*, *Heleocharis kuroguwai*, *Carex hypoblephara*, *C. scabrisacca*, *C. Tangiana*, *Desmodium austro-japonense*, *Mucuna Irukanda*, *Polygala riukiensis*.

**78. Symbolae ad floram Asiae orientalis 14.** (With Japan. résumé). Jisaburo OHWI. (Acta Phytotax. et Geobot. **5**, 1936, 179-188).

*Strobilanthes Towadanus*, *Astragalus shinanensis*, *Mucuna iriomotensis*, *Vicia chosonenensis*, *Thalictrum microspermum*, *Carex Echinus*, *Fimbristylis Shimodanus*, *Euonymus oligospermus*, *E. fungosus*, *E. platycline* are new species.

**79. A revision of the Japanese species of Calamagrostis.** (Japanese and Latin). Jisaburo OHWI. (Acta Phytotax. et Geobot. **5**, 1936, 225-242).

Altogether 18 species of the genus *Calamagrostis* are enumerated.

**80. Contribution to the knowledge on the soil microflora of Pseudosasa-association III. Inoculation test with rhizobia.** Yonosuke OKADA. (Sc. Rpts., Tôhoku Imp. Univ. 4th Ser. **11**, 1936, 253-258, 2 text-figs.).

In humous soil of *Pseudosasa*-association in Mt. Hakkôda, Northern Japan, no leguminous plants were ever observed to grow naturally. The purpose of the author's study is to determine, whether the rhizobia are really absent in this soil or notwithstanding their presence they are not able to infect on account of the acid nature of soil. The original soil with its pH = 5.2 was made alkaline (pH = 7.8-7.9) by the addition of either  $\text{CaCO}_3$  or  $\text{CaCO}_3 + \text{K}_2\text{HPO}_4$ . *Vicia faba*, *Pisum sativum* and *Phaseolus vulgaris* were planted on untreated original soil as well as soil made alkaline by the above treatment. The plants were either inoculated with nodule bacteria (*Rhizobium leguminosarum* and *phaseoli*) or not. It was ascertained that though the plants grow much better in treated soil than in untreated, and no nodule formation took place when no inoculation was practised, yet they are able to grow on original soil. The experiments show thus that no nodule bacterial are present in humous soil under discussion.

**81. On a new Prasiola from Formosa.** (Japanese with the explanation of plate, etc. in English). Yoshikadzu OKADA. (Jour. Japan. Bot. **12**, 1936, 451-459, 9 text-figs.).

In Japan two species of *Prasiola* were hitherto known, viz. *P. japonica* and *crispa*. The present species found recently in Formosa is much allied to the latter.



but may be easily distinguished from it by the shape and thickness of thallus, the mode of arrangement of cells, the shape and size of vegetative cells in surface view and cross section.

**82. Report of some Japanese fresh-water algae (III).** (Japanese and English). Yoshikadzu OKADA. (Jour. Japan. Bot. **12**, 1936, 679-682, 1 fig.-group).

3 species of *Oedogonium* and 1 of *Bulbochaete* are noticed.

**83. Notes on Japanese desmids, with special reference to the newly found species IV.** (With Japanese résumé). Yoshikadzu OKADA. (Bot. Mag. Tôkyô **50**, 1936, 430-434, 1 pl., 471-473).

**84. On the inheritance of two mutations in rice-plants induced by X-ray irradiation.** (Japanese with English résumé). Gunkiti ÔRYÔZI. (Jour. Taihoku Soc. Agric. & Forest. **1**, 1936, 231-296, 1 pl.).

By treating seeds of rice-plant under pure culture by X-ray the author has got two kinds of mutants. One of them is the dwarf plant, which was found to breed true through several generations, and which by crossing with normal plants was proven to be a monofactorial recessive. The other mutant is the striped plant. The cross normal green ♀ × striped ♂ gives always to normal green exclusively, while striped ♀ × normal green ♂ gives besides some albinos only striped offspring and never normal green. Whence the author comes to the conclusion that in this case he has to deal with the well known plastid inheritance. Furthermore, the selfing of striped plants gives besides striped a certain number of half-striped (some shoots striped and some others green) and green. Greens do not breed true by selfing, for they give rise besides greens always to a certain number of striped offspring. The author thinks that the green plant in this case contains normal as well as few abnormal chloroplasts, the latter being apparently overshadowed by numerous normal ones, so that the plants look outwardly just like normal green ones.

**85. Über einige für die Kultur von Aspergillen notwendigen Schwermetalle und das Befreiungsverfahren der Nährlösung von ihren Spuren.** Tetsu SAKAMURA. (Journ. Fac. Sci., Hokkaido Imp. Univ., Series V, **4**, 1936, 99-116, 2 Textfiguren).

Um die Nährlösung der Pilzkultur von Verunreinigung in geringen Spuren zu befreien, ist das Adsorptionsverfahren durch die Kohlenbehandlung bisher von mehreren Forschern verwendet worden. Da aber die Kulturversuche mit der so vorbehandelten Nährlösung und auch die polarographischen Untersuchungen zeigten, dass die Reinigung manchmal unbefriedigend stattfindet und dass Mn von Kohle abgegeben wird, wurde Ca-Phosphat statt der Kohle als Adsorptionsmittel einer Prüfung unterzogen. Aus einer Reihe von Kulturversuchen mit Aspergillen lässt sich die brauchbare Methodik des Adsorptionsverfahrens mit Ca-Phosphat folgendermassen zusammenfassen:

1. Die Salzkonzentration der Kulturlösung entspricht der Hälfte derjenigen der PFEFFERSchen Lösung, und die Glukosekonzentration beträgt m/2 oder m/4.
2. Das mit Glasdestillierapparat umdestillierte Wasser wird gebraucht.
3. Fünfzig g Ca-Phosphat wird in 1000 ccm umdestilliertem Wasser suspendiert, und die Suspension wird 5 Stunden lang geschüttelt. Während dieses Waschverfahrens wird Wasser viermal gewechselt, und nach der Filtration Ca-Phosphat unter Verwendung aschenfreien Filtrierpapiers luftgetrocknet.

4. Die Kulturlösung wird mit 0.5% Ca-Phosphat versetzt und mittels NaOH auf pH 5.5 gebracht. Das Adsorptionsverfahren geschieht 2 Stunden lang auf dem Schüttelapparat. Die Suspension zweimal filtriert, und das Filtrat, dessen pH-Wert meistens 5.7 beträgt, kommt fertig zum Gebrauch als die Kulturlösung.

5. Kulturgefäß muss kein Zink enthalten und auch keine anderen Schwermetalle in die Lösung gehen lassen. Bei uns ist z.B. Terex Glas brauchbar für diesen Zweck.

6. Je nach dem Versuchszweck wird eine bestimmte gemessene Menge der Schwermetalle in die Kulturlösung zugesetzt.

7. Keine Trockensterilisation des Kulturgefäßes. Die Dampfsterilisation der Kulturlösung im Kulturgefäß dauert 20 Minuten bei 100°C im Dampftopf.

Die Beseitigung der Schwermetalle in der Kulturlösung erfolgte nach der Methode des Verfassers in dem Masse, dass *Aspergillus niger* die nachdem Adsorptionsverfahren zugesetzten Schwermetalle in folgenden Konzentrationen als notwendig empfinden konnte:

Fe  $10^{-7}$  mol (nach dem Pilzgewicht)

Zn  $10^{-7}$ , deutlicher  $10^{-6}$  mol (nach dem Pilzgewicht)

Cu  $10^{-7}$  mol (nach der Konidienfarbe)

Mn  $10^{-6}$  mol (nach der Kugelzellbildung und der Faltung der Pilzdecke)

Die polarographische Kurve zeigte, dass Ca-phosphat keine merklich wirksame Substanz in auffälliger Menge abgibt und dass das Adsorptionsverfahren damit die Kulturlösung befriedigend reinigen kann. Verfasser.

**86. Beobachtungen über japanische Moosflora XIc, XII a-b.** (Mit japan. Zfg.). Kyuichi SAKURAI. (Bot. Mag. Tôkyô **50**, 1936, 370-374, 406-407, 514-520, 618-624, im ganzen 15 Textabb.).

Beschreibung von folgenden neuen Arten: *Brachythecium Yamamotoi*, *B. Momoseanum*, *B. plumosum*, *Homothecium perfliferum*, *H. excavatum*, *Pogonatum sordide-viride*, *Polytrichum higoense*, *Fissidens Magerbarae*, *Dicranodontium tenuinerve*, *Dicranum orthothecium*, *Didymodon percarinatus*, *Hymenostomum strictifolium*, *Merceya kiusiana*, *Mnium Konedae*, *Duthiella myuriformis*, *Cyathophorella grandistipulacea*, *Homalia laeviretis*, *Schwetschkea polymorphidens*, *Glossadelphus recurvo-marginatus*, *Rhynchostigium sinanense*, *Isopterygium rubro-punctatum*.

**87. Boehmeria japonica.** Yosisuke SATAKE. (Jour. Fac. Sc., Imp. Univ. Tokyo, Section III, **4**, 1936, 467-542, 54 text-figs.).

Hitherto nearly 18 species and 3 varieties of the genus *Boehmeria* were known in Japan, but the author's study has added to them 19 species, 2 varieties and 4 forms, so that we have now 40 species, 5 varieties and 4 forms in all.

The subdivisions of the genus are founded on various characters, of which that of achenes is one of the principal ones. The anatomical structure of the petiole is also taken into consideration, and the author gives the key for the species determination according to this characteristics. Among the species enumerated the following are new: *B. egregia*, *Nakaiana*, *hirtella*, *kiyozumensis*, *arenicola*, *tenuifolia*, *minor*, *tilifolia*, *kiusiana*, *pannosa*, *gigantea*, *quelpaertensis*, *villigera*, *praestabilis*, *pachystachya*, *dura*, *izuosimensis*.

**88. Trivial notes on Japanese plants II.** (Japanese). Yosisuke SATAKE. (Jour. Japan. Bot. **12**, 1936, 575-577, 2 text-figs.).

*Juncus hizensis* sp. nov., *J. nikoensis* SATAKE var. *pinifolius* var. nov. are described.

**89. *Aloe variegata* and its intergeneric hybrids.** (Japanese). Dyûhei SATÔ. (Bot. & Zool. **4**, 1936, 1288-1290, 10 text-figs.).

Karyological studies of the author on root-tips in *Aloe variegata* as well as *Gasteria verrucosa* var. *latifolia* have shown that there two pairs of large chromosomes are satellited in contrast to the statement of TAYLOR and in accordance with that of HEITZ and RESENDE. In the hybrid between the two forms above cited the satellite is present, though according to NAWASHIN it will disappear in the hybrid of *Crepis*. In the hybrid *Gasteria gyûzetu*  $\times$  *Aloe variegata* only 3 satellites were visible.

**90. Chromosome studies in *Scilla* II. SAT-chromosomes in the karyotype analysis in *Scilla* and other genera.** Dyûhei SATÔ. (Cytologia **7**, 1936, 521-529, 11 text-figs.).

It is now generally accepted that the nucleoli are formed on SAT-chromosomes and consequently the number of the nucleoli in each nucleus must correspond to that of the SAT-chromosomes contained therein, though in later stages this may be obscured by the fusion of nucleoli. This correspondence was observed by the author in some species of *Nerium*, *Gasteria* and *Scilla*.

**91. Analysis of karyotypes of *Scilla permixta* and the allied species with special reference to the dislocation of the chromosomes.** Dyûhei SATÔ. (Bot. Mag. Tôkyô **50**, 1936, 447-456, 21 text-figs.).

The karyotypes of *Scilla peruviana* as well as its var. *alba* are similar to each other, and may be designated as  $2n = 16 = 2L + 8M + 6S$  ( $L$  = long,  $M$  = medium,  $S$  = short). Among 6S two which are called  $S_s$ -chromosomes bear each one satellite at their respective distal end. In respect to the karyotypes of *Scilla permixta* we may distinguish three types, of which the A-type is similar to that above indicated. In the B-type one of the two  $S_s$ -chromosomes (i.e. satellited) is wanting (i.e.  $2n = 15 = 2L + 8M + 5S$ ), and in the C-type both (i.e.  $2n = 14 = 2L + 8M + 4S$ ). In the latter type, however, one M-chromosome (called  $M_s$ ) bears one satellite at its distal end, which is never present normally; this phenomenon should be due to the translocation of one  $S_s$ -chromosome.

In *Scilla ughii* we may distinguish a number of karyotypes, and it is considered that they are of hybrid or triploid origin.

**92. Beiträge zur Kenntnis der Farnverbreitung in der Kagoshima-Präfektur.** (Japanisch mit latein. Diagnosen). Kansay SATÔ. (Jour. Japan. Bot. **12**, 1936, 823-828, 4 Textabb.).

*Plagiogyria yakushimensis* is new und beschrieben mit Abbildungen. 7 andere Farnarten sind auch erwähnt.

**93. Enumeratio lichenum Ins. formosae II.** (Mit japan. Zfg.). Masami SATÔ. (Jour. Japan. Bot. **12**, 1936, 569-575, 1 Textabb.).

5 Arten *Physcia*, 3 *Pyxine*, 2 *Rhizodina*, 3 *Buellia*, 1 *Theloschistes*, 2 *Caloplaca*, 3 *Bombyliospora*, 1 *Protoblastenia* sind erwähnt. *Protoblastenia formosana* ZAHLBRUCKNER ist bisher nur in Formosa beobachtet worden.

**94. Notes on the lichen flora of Tisima or Kuriles.** (With Japan. résumé). Masami SATÔ. (Bot. Mag. Tôkyô **50**, 1936, 610-617, 1 text-fig., 648-649).

This list comprises 9 families, 19 genera and 34 species, all of which are also found in Sachalien, Hokkaidô and Nippon, except *Lobaria linita* (ACH.) RABENH.

**95. The height and number of rays in some coniferous woods.** (With Japanese résumé). Misaburô SHIMAKURA. (Bot. Mag, Tôkyô **50**, 1936, 438-447, 474-475, 5 text-figs.).

Disks were cut out from woods of some conifers (10 genera, 11 species, and 25 specimens). Using them as the materials, the author has studied the variation of the height of xylem-rays, their distribution (= their number per unit area of tangential section) as well as their quantity (total number of cells composing them per unit area). The results of the author's observations are as follows. Disregarding certain variations, increase and decrease in the height of rays (except in the central rings) correspond to the degree of diameter growth. The number of rays which is largest in the first ring changes in the succeeding inversely to that of their height. Ray volume, although large in the several first rings, goes down to the last one. The height and volume of the rays vary with the density of annual rings: wide-ringed wood has higher rays and more numerous ray cells than in the narrow-ringed ones. The number of rays shows no definite correlation to the width of ring.

**96. Über die Keimungsversuche des Pollens von *Eriobotrya japonica*.** (Japanisch). Makoto SISA. (Agric. & Hort. **11**, 1936, 2145-2154, 2369-2386, 11 Textabb.).

Nach der Angabe Verfs. erstreckt sich die Blühendauer von *Eriobotrya japonica*, welche ziemlich lang ist, von November bis zu März des nächsten Jahres, z. B. in Kyôto. Die Rate der sterilen Pollenkörner ist niedrig und beträgt kleiner als 5%, obgleich zum Ende der Blütenperiode sie bis zu 14% zuzunehmen beobachtet wurde. Für die Versuche der künstlichen Keimung hat der Verf. mit guten Erfolgen 4/10 m (= 3,6%) Rohrzuckerlösung mit Zugabe von 1% Agar gebraucht, wobei optimaler pH = 5,5. Die Keimung tritt erst ein bei über 10°C, Optimum 20-21° (70% Keimung), bei 35° schlechte Keimung. Die Pollenkörner aus den Blüten im Knospenzustande kann man nicht künstlich keimen lassen, doch sind diejenigen aus halbgeöffneten Blüten keimfähig. Diejenigen aus den gerade aufgesprungenen Staubbeuteln zeigen die höchste Keimungsrate, z.B. 90%. Die Pollenkörner, welche unter niedriger Temperatur aufbewahrt worden sind, keimen schlecht, während diejenigen, welche um  $\pm 20^{\circ}\text{C}$  gehalten worden sind, vorzüglich keimen können.

Die jungen Pollenkörner sind mit Stärkekörnern vollgepfropft. Allmählich nehmen die letzteren ab parallel mit dem Wachsen des Pollens bis zu seinem alten Stadium, wobei sie ganz verschwinden und dann erst wird er keimfähig.

**97. Karyological study of *Spirogyra* by means of nucleal-reaction.** S. SUEMATSU. (Sc. Rpts. Tokyo Bunrika Daigaku. Section B, Nos. **46-47**, 1936, 35-40, 1 pl.).

Three species of *Spirogyra*, whose specific name is unknown, were studied by means of FEULGEN's nucleal-reaction method. The results are in perfect accord with those of the author's predecessors, such as GEITLER, who recognizes the fact that the nucleus of *Spirogyra* is quite identical in structure and substance to that of higher plants. The chromatic granules seen in the nucleus of *Spirogyra* correspond in number to the prochromosomes in prophase, and the chromosomes in metaphase. Chromatic granules, prochromosomes and chromosomes react positively towards FEULGEN, while the nucleolus and the nucleolar substance derived from it negatively.

**98. Studies in the chromosome number in higher plants, with special reference to cytokinesis.** Toranosuke SUGIURA. (Cytologia **7**, 1936, 544-595, 246 text-figs.).

This paper contains principally the description of chromosomes in a great number of plants with illustrations (cf. Japan. Jour. Bot. **8**, (110), No. 465). The size



of chromosomes during meiotic and somatic divisions was measured, and the results are shown in an extensive table. According to the author the pollen formation by furrowing process is far more widely prevalent as hitherto recognized, both in dicotyledonous and monocotyledonous plants.

**99. List of chromosome number and idiogram types in Liliaceae and Amaryllidaceae (III).** Tiharu SUTÔ. (Jour. Japan. Gen. **12**, 1936, 221-231).

The list indicated in the above title is the collection of the results of studies of various authors inclusive the present author himself. The bibliography closes the paper.

**100. Studies in bacteria in the interior of rice seeds (4)-(5).** (Japanese with English résumé). Hashio SUZUKI. (Bot. & Zool. **4**, 1936, 1746-1754, 2 text-figs.; Ann. Phytopathol. Soc. Japan **6**, 1936, 219-253, 15 text-figs.).

Ad (4). In either of *Bacillus* A and B (cf. Japan. Jour. Bot. **8**, (80), No. 326) the maximum temperature for its respective growth at 24th hour after the beginning of their culture is always the same in all strains, viz. 35-40°C, while in all strains of C optimum temperature for the same process at 24th hour is 25-30°C. Maximum, optimum and minimum temperature for various strains of each *Bacillus* at various times are manifold and impossible here to be noticed in detail.

The optimum and maximum temperature for the isolation of bacteria from rice seeds are different in different materials, for instance, optimum 25-35° or 30-40°, maximum 35-40° or 40-45°.

Ad (5). The author has studied in various strains of A, B and C *Bacillus* the thermal death point under different temperatures (for instance, 47.5°, 50°, 52.5°, 55°) in relation to hydrogen ion concentration of the nutrient medium and the time duration. To cite below some instances at 47.5° ± 0.5°C. In *Bacillus* A death ensues under this temperature between 35-60 min. at pH 5, between 15-50 min. at pH 8.6-8.8, after more than 60 min. at pH 7.0-7.2. In *Bacillus* B after more than 60 min. at pH 5.0 and 7.0-7.2, between 25-35 min. at pH 8.6-8.8. In *Bacillus* C after more than 60 min. at any pH, etc., etc.

**101. The occurrence of *Neurogramme vestita* DIELS in Taiwan.** (Japanese with English résumé). SUZUKI-Tokio. (Jour. Japan. Bot. **12**, 1936, 743-745, 1 text-fig.-group).

**102. Miscellaneous notes on the East-Asiatic pteridophytes with special reference to the Japanese species I-III.** (With Japanese résumé). Motozi TAGAWA. (Jour. Japan. Bot. **12**, 1936, 486-495, 537-544, 746-755).

Among others the following species are described as new: *Colysis megalolepis*, *Thelypteris viridifrons*, *Athyrium frangulum*, *Microsorium Ohwianum*.

**103. A review of the genus *Woodwardia* of Japan.** (Japanese). Motozi TAGAWA. (Acta Phytotax. et Geobot. **5**, 1936, 167-178).

**104. *Spicilegium pteridographiae Asiae Orientalis* 11-12.** (With Japan. résumé). Motozi TAGAWA. (Acta Phytotax. et Geobot. **5**, 1936, 189-197, 250-262).

*Microlepia mollifolia*, *M. substrigosa*, *Dryopteris oblancifolia*, *D. sublaevifrons*, *D. Doiana*, *D. koraiensis*, *Woodsia Saitoana*, *W. intermedia*, *W. pseudo-ilvensis*, *W. longifolia*, *Polystichum piceo-paleaceum*, *P. Doianum*, *P. pseudo-Makinoi*, *Diplazium taiwanensis*, *D. phaeolepis* are contained.



**105. Über die aus den haploiden Reispflanzen hervorgegangenen Individuen.** (Japanisch). Hiroyuki TAKAHASHI. (Proc. Crop Sc. Japan 8, 1936, 356-363, 1 Textabb. gruppe).

Die Kreuzung, Haploid  $\times$  Diploid bei Reispflanz, wurde ausgeführt, von denen die erstere Pflanze diejenigen ist, welche zuerst vor einiger Zeit von MORINAGA aufgefunden und untersucht worden ist (vgl. Japan. Jour. Bot. 7, S. 73 u. Folg.). Obgleich eine grosse Anzahl von Ährchen für die Kreuzung benutzt worden sind, sind daraus bloss 74 Samenkörner entstanden, unter denen 40 aus den durch somatische Mutation diploid gewordenen Ährchen abstammend sind. Sowohl solche als die aus den im haploiden Zustande gebliebenen Ährchen bekommenen samen wurden gesät und die daraus abstammenden Individuen wurden zytologisch untersucht. Weiter, einige andere Haploiden wurden in vegetativer Wege vermehrt und die daraus bekommenen Körner waren ebenso teilweise aus den haploiden, teilweise aus den zum diploiden Zustande mutierten Ährchen bekommen. Die daraus hervorgekommenen Pflanzen wurden auch zytologisch untersucht.

Die Resultate der Beobachtungen Verfs. sind wie folgt. Die Samenkörner aus den Haploiden sind bedeutend kleiner als dieselben aus Diploiden. Die aus den Haploiden abstammenden Nachkommen zeigen jedoch keinen wesentlichen Unterschied in ihren Merkmalen gegenüber denjenigen aus den Diploiden. Durch die zytologische Untersuchung der Wurzelspitzenzellen kann der Verf. sich davon überzeugen, dass dabei 24 Chromosomen vorhanden sind, was zeigt, dass die Pflanzen schon innerlich zum diploiden Zustande zurückgekommen sind.

Es ist bisher von einigen Forschern behauptet worden, dass die 24-chromosomige Reissippe tetraploid ist, wozu der Verf. kaum beistimmen kann.

**106. Studies on the linkage relations between the factors for endosperm characters and sterility in the rice plant, with special reference to selective fertilization.** Noboru TAKAHASHI. (Bull. Agric. Exp. Sta., Gov.-Gen. of Chosen (Corea), No. 5, 1936, 74 pp, 16 tables).

In  $F_2$  generation derived from the hybrid plant between the rice strains with starchy and glutinous endosperm (U-u) respectively several sterile individuals have appeared, which are supposed to be the results of gene mutation in previous generation of D (fertility) to d (sterility). The pedigree culture of a considerable number of families during 4 generations was executed, and on the basis of these experiments it was ascertained that the factors D and U are strongly linked, the crossover value between them being approximately 2.2%.

The ratio of sterile plants in the segregation families of the heterozygote Dd is considerably smaller than might be theoretically expected on the basis of monohybrid Mendelian segregation, thus, for instance, about 16% instead of 25%. Concerning the endosperm characters the number of glutinous plants in the progeny of DdUu-type was but 16.71%, which is also markedly deficient from the theoretical viewpoint.

The types DDUU, DDUu and DdUu were found to be fertile to the same degree, and the number of spikelets per ear was nearly alike, while ddUU, ddUu and dduu were only 17.00% fertile on the average, and the number of spikelets per ear was about half that in the former types. It was suggested that the factor d disturbs the pollen-grains to a certain degree at the time of fertilization, so that the male gametes bearing the factor D executes the fertilization 1.5 times as often as those bearing d (100D:64d).

**107. An ecological study of vegetation in the province of Jehol, Manchoukuo.** (With Japanese résumé). Motoo TAKAHASI. (Report of the first scientific expedition to Manchoukuo under the leadership of Shigeyasu TOKUNAGA, June-October 1933, Sec. IV, Part III, 1936, 55 pp, 161 text-figs., and 3 tables).

The province of Jehol which lies between  $40^{\circ}19'-43^{\circ}30'N$  and  $120^{\circ}1'50'E$ — $116^{\circ}54'W$  occupies an area of 14000 km<sup>2</sup>. Its southern part is mountainous, and towards the north it gradually diminishes in height till the extreme north, where there is a mere plain but with a few hills. The climate of the northern part is typically continental: in cold season the temperature descends till  $-30^{\circ}C$ , and in hot season it rises till  $40^{\circ}C$ . The amount of precipitation is small, maximum 800 mm and minimum less than 200 mm. The yearly mean humidity is  $\pm 60\%$ , and in April and May it falls down to  $\pm 50\%$ . The amount of evaporation is pretty large, being 1300–1700 mm. The duration of sunshine is long in summer, owing to the large number of clear days. The annual sunshine total is estimated at 2600–3000 hours. Wind blows in the north all the year round, the direction being from NW or N, and its velocity 4–7 m/sec. on the average. The pH value of soil is 6.8–7 in the south, but in the north it may be even as much as 9; above 8.5 only two species, viz. *Juncellus pannonicus* and *Salsola corniculata* were seen growing, while above 8.7 no plants were ever observed to grow. As to the water-holding capacity of soil it is greatest in forest region in the south, which is rich in humus, then comes the clay and loam in the north; it is smallest in the sandy region in the north, where, for instance, in the sand-dune only one species, *Agriophyllum arenarium* was seen growing. Between the south and the north lies the sandy loam which is intermediate in its physical characters. As to the chemical nature of soil that in the north is rich in various inorganic salts, especially those of sodium and potassium, but poorer in nitrogenous and humus substances than in the south. The barren condition in Jehol at the present time is due, as the author remarks, to the devastating work of men in the south, and to that of aeolian sand in the north. The damage done by the grazing of flocks of goats and sheep has no less contributed to this desolate condition. The author, in enumerating plants of the south and the north, has classified them according to different soil nature (sandy loam and sandy, strongly alkaline in the north) and different heights (less than or exceeding 1000 m etc. in the south).

**108. Further reports of cytological and genetic investigations of *Rumex acetosa* L. II. Polyploid plants and their offspring.-III. On male and female intersex plants.** (Japanese with English résumé). Yô TAKENAKA. (Bot. & Zool. 4, 1936, 1193–1204, 5 text-figs. Jour. Chosen Nat. Hist. Soc. No. 21, 1936, 58–76, 2 text-figs.-groups).

All diploid or triploid intersexual plants of *Rumex acetosa* agree in having the chromosome formula  $22 = 18a + 2X + 2Y$  or  $15 = 12a + X + 2Y$  respectively. Yet the sexual intensities as well as floral structures are not uniform in different individuals belonging to each of the two kinds of intersexual plants just indicated. Seeds produced by natural fertilization give rise to the offspring with various chromosome complements, which may be classified as male  $\sigma$ , male intersex  $\pm \sigma$ , intersex (almost all flowers hermaphrodite), female intersex  $\pm \varphi$  and female  $\varphi$ . The reduction division of the pollen mother-cells is irregular, especially in the case of triploid plants, and then we observe the conjugation of certain autosomes with either X- or Y-chromosome. The latter phenomenon is considered to be due to the distribution of homologous genes in the non-homologous chromosomes.

The sexual disturbance on the male and female intersexual plants as above mentioned is, according to the authors, quite independent from either X- or Y-chromosome, but connected with the action of few autosomes which are transformed from the normal ones by deficiency, deletion, inversion, translocation, dislocation or attachment. The production of intersexual plants by the cross *Rumex acetosa*  $\times$  *R. montana*, that between various races of *R. acetosa*, and also in the progeny of the germ-cells treated by X-rays, all such sexual disturbances may be explained in the same way.

**109. On the reasonable use of soil point for the determination of the water-supplying power of soils.** (Japanese with English résumé). Torataro TAMAI. (Bul. Sci. Fak. Terk. Kjušu Imp. Univ. **7**, 1936, 1-33).

The author sought to obtain an empirical formula for the absorbing process of soil point, and by means of this formula, to ascertain the most suitable time-period for using the soil point to determine the water-supplying power of soils. The formula  $x = at^b$  (formula I) was thereby found, where  $x$  is the amount of water absorbed by a soil point in the time period  $t$ , and  $a$  and  $b$  are coefficients varying in value with the soil type and the soil moisture condition.

As the reasonable standard amount of water absorbed by the soil point, which has such a character, the amount 0.5 gr. was taken. The absorption time period  $t$  was therefore calculated by substituting  $x = 0.5$  in the above mentioned formula. The method of determining the water-supplying power of soils, applying this calculated time period  $t$ , may be either one of the following two different procedures.

The first method: Two or more tests to determine the amount of water absorbed by the soil point must be made with a given soil in different absorbing time-periods, and the value of the two coefficients ( $a$ ,  $b$ ) in the formula I are calculated from the data. Then by substituting  $x = 0.5$  gr. the value of corresponding time period ( $t'$ ) is calculated. Now a soil point test with the time period thus calculated is made in the given soil and the actual amount of water absorbed ( $x'$ ) found is, which is naturally approximately equal to 0.5 g. Selecting 10 min. as the standard time-period for the soil point test, the formula  $S = 10x'/t'$  (formula II) is constructed, where  $x = x'$ ,  $t = t'$ , and  $S$  = the amount of water to be absorbed within 10 min. The value of  $S$  is used as the index of water-supplying power of the given soil.

The second method: After calculating the time period  $t'$ , the value of  $t'$  is substituted directly for  $t$  and 0.5 for  $x$  in the formula II, and the value of  $S$  is calculated.

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**110. Genetic and cytological studies on the  $F_1$  hybrid of scarlet or tomato egg-plant (*Solanum integrifolium* POIR.)  $\times$  egg plant (*S. Melongena* L.).** (Japanese with English résumé). Tamio TATEBE. (Bot. Mag. Tôkyô **50**, 1936, 457-462, 20 text-figs.).

The  $F_1$  hybrid, scarlet (or tomato) egg-plant (*Solanum integrifolia*) by *Solanum Melongena*, which is distinguished by its extreme vigour produces numerous short adventitious roots in the lower part of the shoot, which is never seen in either parent. It is perfectly sterile, both on male and female sides, and small seedless fruits are produced.  $n = 12$  in each parent. The meiosis in PMC is quite regular, but the microspores disorganize soon after their liberation.

**111. Geschlechtschromosomen bei einigen Lebermoosen. IV. Geschlechtschromosomen bei zwei *Frullania*-Arten.-V. Geschlechtschromosomen bei einigen *Frullania*-Arten.** (Japanisch mit deutsch. Zfg.). Seizi TATUNO. (Bot. Mag. Tôkyô **50**, 1936, 401-405, 526-531, im ganzen 37 Textabb.).

Bei *Frullania japonica*, *Fauriana* und *squarrosa* sind je drei durch Heteropyknose ausgezeichnete Geschlechtschromosomen  $X_1$ ,  $X_2$  und Y sichtbar, und ihre Chromosomenformel ist ♀  $9 = 7 + X_1 + X_2$ , ♂  $8 = 7 + Y$ .

$$F. dilatata \begin{cases} \text{Gametophyt} & \text{Sporophyt} \\ 9 = 7 + X_1 + X_2 & 17 = 14 + X_1 + X_2 + Y \\ 8 = 7 + Y & \end{cases}$$

Bei *F. moniliata* ist die Formel  $9 = 7 + H + h$ , wobei die Heterochromosomen H und h nicht als Geschlechtschromosomen anzusehen sind, weil die Heterochromosomen sowie die anderen Chromosomen des weiblichen Thallus denen des männlichen ganz gleichartig sind.

**112. Physiology of *Chromatium gracile* STREZESZEWSKI.** (With Japan. résumé). Shozo TOKUDA. (Bot. Mag. Tôkyô **50**, 1936, 393-400).

The author has succeeded in getting the pure culture of *Chromatium gracile* living naturally in the mud of the bed of Simoda Bay. He has obtained its pure colonies in agar column which were then transferred into the VAN NIEL's solution (each of  $\text{NH}_4\text{Cl}$ ,  $\text{NaHCO}_3$ ,  $\text{K}_2\text{HPO}_4$ ,  $\text{MgCl}_2$ ,  $\text{Na}_2\text{S}$  1 gr for 1l  $\text{H}_2\text{O}$ , and were then observed to live under wholly anaerobic condition. Pure culture in an agar plate was obtained by being enclosed in the mixture of  $1 \text{H}_2\text{S} + 2\text{CO}_2 + 27\text{H}_2$ . Ammonium salts are better suited to the growth than nitrates as nitrogen source, while  $\text{NaHCO}_3$  and  $\text{Na}_2\text{CO}_3$  are suitable source of C, though carbohydrates may be used as such when carbonates are not present. The pH-value for the development of bacteria lies between 6.0-8.0, 7.0 being the optimum. The ultra-violet ray is effective for their growth.

**113. Über den Einfluss des Bors auf das Wachsen der Reispflanze.** (Japanisch mit deutsch, Zfg.). Matuo TOKUOKA und Hitosi MOROOKA. (Jour. Soc. Trop. Agric. **8**, 1936, 211-220).

Die Reispflanzen wurden auf dem Boden gepflanzt, zu welchem eine kleine Menge Bors hinzugefügt wurde. Die Tatsache, dass das Bor, obgleich es für das Wachsen der Pflanze entbehrlich ist, darauf eine befördernde Wirkung ausübt, wurde konstantiert. So z.B. beobachtet man die Vermehrung der Bestockungszahl, die Zunahme der Kornzahl für jede Rispe, und die Verstärkung der Keimungskraft von Körnern. Bemerkenswert ist die Entwicklung von *Cladosporium* bei Zugabe einer zu grossen Menge des Bors.

**114. The influence of environmental conditions on the artificial germination and vitality of pollen in *Allium odorum* L.** (Japanese with English résumé). W. H. TSU. (Japan. Jour. Gen. **12**, 1936, 278-284, 2 text-figs.).

According to the results of experimental studies of the author concerning the artificial germination of pollen of *Allium odorum* on agar with sugar  $25^\circ\text{C}$  is the optimum temperature, and the number of burst pollen increases with the rise of temperature. For the preservation of pollen vitality low humidity, for instance, 40%, low temperature, for instance,  $8^\circ\text{C}$ , and air-tight condition are effective. Light has no influence at all on vitality as well as on germination.

**115. Phytoecological studies on the maritime vegetation on the seaside of Taitô, Tiba Prefecture.** (Japanese with English résumé). Michio TSUDA. (Bot. Mag. Tôkyô **50**, 1936, 463-469, 3 text-figs.).



The soil in sandy seashore of Taitô in Tiba Prefecture covered with the vegetation contains a very low salt quantity in comparison with dry soil, thus, for instance, 0.003–0.006% NaCl. In a community where *Carex Kobomugi* is growing the soil is however richer in salts, thus 0.0099% NaCl and 0.115% Na<sub>2</sub>SO<sub>4</sub>. The soil is intensely alkaline, pH being 7.4–8.8, and the lowest value 7.4 is found at a distance of about 70 m or more from the seashore.

**116. Some diatoms from the clod of Shichimenzan, Kosu, Japan.** Kôhei TSUMURA. (Jour. Japan. Bot. **12**, 1936, 734–742, 36 text-figs.).

**117. Plantae boninenses novae vel criticae VI-VII.** (With Japanese résumé). Takasi TUYAMA. (Bot. Mag. Tôkyô **50**, 1936, 374–379, 408–409, 425–430, 470–471, altogether 6 text-figs.).

The following new species are described: *Tarachia nucantifrons*, *Sciaphila boninensis*, *S. Okabeana*, *Zeurine tenuifolia*. 8 species of *Crepidiastrum* are enumerated. Besides, *Sedum boninense* is described and *Peucedanum boninense* comb. nov. cited.

**118. Mikrurgische Untersuchungen lebender Zellen in der Teilung IV. Die Einwirkung der Austrocknung auf die Mitose bei den Staubfadenzellen von *Tradescantia reflexa*.** Bungo WADA. (Cytologia **7**, 1936, 363–370, 2 Taf.).

Als das Material des Versuches wurden die in Teilung begriffenen Staubfadenhaarzellen von *Tradescantia reflexa* in einen hängenden Tropfen von 2% Rohrzuckerlösung gebraucht. Der Erfolg des Austrocknens ist dem der Plasmolyse ähnlich (vgl. Japan. Jour. Bot. **8**, (112), Nr. 475), weil dabei die Chromosomen infolge des Verlustes des Quellungswassers zum Chromonemazustande gehen und durch die nachherige Aufnahme des Wassers ihre Spiralwindungen abwinden und sich zum Ruhekernzustande reduzieren. Der schliessliche Erfolg des Austrocknens ist jedoch nach den Mitosestadien verschieden. Wenn nämlich das Austrocknen zur Zeit der Meta- und Anaphase einwirkt, entsteht ein Syndiploidkern, aber bei der späteren Anaphase und den nachfolgenden Stadien entsteht eine zweikernige Zelle mit oder ohne Scheidewandrudimenten. Der Prophasekern kehrt durch schwaches Trocknen leicht zum Zustande des Ruhekernes zurück.

**119. Über eine neue Gattung der Cytinaceae.** (Mit japan. Zfg.). Kiyohiko WATANABE. (Bot. Mag. Tôkyô **50**, 1936, 676–680, 2 Textabb. gruppen, 698).

*Cytinus Baroni* aus Madagascar wurde 1888 von BAKER wegen des eigentümlichen Baues unter einer besonderen Untergattung *Botryocytinus* angeordnet. HARMS, welcher darauf nicht besonders geachtet hat, hat diese Art mit einigen anderen unter einer Sektion zusammengebracht. Der Verf., welcher auf den eigentümlichen Bau dieser Art Gewicht legt, hat dafür eine neue Gattung *Botryocyanus* errichtet und eine Diagnose angegeben. Die Hauptunterschiede dieser Art von den anderen sind die folgenden: 1. Ausbildung einer einzigen Blüte am Ende des verzweigten Stengels. 2. völliger Mangel des Griffels an männlichen Blüten und die Bildung eines Hohlräume durch die Verschmelzung von Staubblättern. 3. Nichtverzweigung des membranartigen Plazentas in weiblichen Blüten und die Stiellosigkeit der Samenanlagen.

**120. Morphologisch-biologische Studien über die Gattung *Mitrastemon*.** Kiyohiko WATANABE. (Jour. Japan. Bot. **12**, 1936, 603–618, 699–711, 759–773, 848–853, ibid **13**, 1937, 14–86, 154–162, 2 Farbentaf. und 50 Textabb.).



Hauptsächlich eine Zusammenstellung der Verfs. früheren Veröffentlichungen in Bot. Mag. Tôkyô und Proc. Imp. Acad. (vgl. z.B. Abstracts in Japan. Jour. Bot. 1936 usw.) mit der Hinzufügung einiger neuen Angaben.

**121. Anatomical studies of the vascular system in the petioles of some species of *Acer*, with notes on the external morphological features.** Shunji WATARI. (Jour. Fac. Sci., Imp. Univ., Tokyo, Sect. III, 5, 1936, 1-74.

The first part of the paper describes in detail the course of the vascular bundles in the nodal region, base, slender part and the top of the petiole of 42 species belonging to 16 sections of *Acer*. The second part discusses generally the types of vascular systems and also certain important histological characters of the petiolar bundles, and deals with external morphology. The foliar gaps of a leaf are three in number, excepting *A. nikoense* (5 gaps) and *A. Oliverianum* var. *Nakaharae* (3, 4 or 5 gaps). In every case a single foliar trace issues from each gap. Entering the petiolar base, foliar traces undergo division, fusion, translocation, twisting, etc., resulting in the formation of the vascular circle in the slender part of the petiole. The vascular circle may be divided into the "dorsal arc", consisting of a certain number of separate bundles, and the "ventral bundle" usually consisting of a single large bundle situated on the chord of an arc. The manner in which the ventral bundle forms may roughly be divided into the following three types: (a) the components of the ventral bundle come only from the two margins of the median foliar trace, (b) most of those from the median trace arise with a small part that issues from the lateral traces, and (c) the size of those from both median and lateral traces are almost alike. Whereas the last type widely prevails, the former two are restricted to a few closely related sections. The number of main vascular bundles on the dorsal arc usually exceeds that of the palmate nerves or leaflets by one or two pairs. The vascular circle for each palmate nerve or petiolule usually consists, at first, of six bundles, viz., the ventral three and dorsal three that are derived respectively from the ventral bundle and the dorsal arc. Soon, each lateral bundle of ventral three fuse together with the neighbouring laterals of the dorsal three to form a pair of large bundles. Running up to a certain height along the nerves, the dorsal and both lateral bundles eventually fuse together and form a continuous arc. In most species, including 93 per cent of the total number of species studied, the complicate vascular system is made more so by the presence of a medullary system, which is observable only at the petiolar top in some species, while it is found throughout the whole part of the petiole in some other species. Some interesting histological characters of vascular bundles are treated. From the viewpoint of external morphology, petioles of all species of the subgenus Intrastaminalia and many of the subgenus Extrastaminalia are characterized by bifacial structure, while the unifacial structure is restricted to a few sections of the subgenus Extrastaminalia (e.g. Sect. Palmata, Sect. Platanoidea, etc.). These external morphological features are, however, quite independent of the various types of vascular systems, and as far as the present observations go, the characteristic features of the vascular system in connexion with unifacial and bifacial structures could scarcely be discerned. Author.

**122. Notes on some Japanese algae VII.** Yukio YAMADA. (Sc. Papers, Inst. Algol. Res., Fac. Sc., Hokkaidô Imp. Univ. 1, 1936, 135-140, 4 pls. and 3 text-figs.).

The following new species are described: *Caulerpa filicoides*, *Nereia intricata*, *Hypoglossum minimum*.

**123. On the theory of the fixation of protoplasm.** (With Japanese résumé). Gihei YAMAHA. (Bot. Mag. Tôkyô **50**, 1936, 624-631, 651-652).

The "fixation of protoplasm" means in its broad sense the preservation of protoplasmic structure, but the meaning of the word "structure" may be various. The fixation of protoplasm by various reagents used in cytology does not preserve its structure as existing under its vital condition. They cause irreversible change of its state, and lead to the utter destruction of its colloidal or physico-chemical structure as existing during its life. Those structures which are quite invisible in living protoplasm but are made visible first after the fixation are nothing but the products of irreversible change or destruction of its colloidal structure by the action of fixatives. The fixation comprises the coagulation and solution of various substances forming living protoplasm, and is the cause of the necrobiosis of protoplasm on account of the poisonous nature of fixatives, so that what we see after the treatment of protoplasm by them may be regarded as one of the necrobiotic stages.

**124. Beiträge zur Kenntnis pflanzlicher Nukleolen.** G. YAMAHA und S. SUEMATSU. (Sc. Rpts. Tokyo Bunrika Daigaku, Sec. B, Nos. **46-47**, 1936, 21-34, 2 Taf.).

Als das Untersuchungsmaterial dienten hauptsächlich die Wurzelspitzenzellen einiger Cucurbitaceen. In den sog. euchromatischen Kernen (karyotinarne Kerne) sieht man an der Kernperipherie eine kleine Anzahl von Karyotinkörnchen (Chromozentren). Die letzteren verhalten sich positiv gegenüber der FEULGENS Färbung. In der Prophase sieht man das gleiche, wenn schwache, Verhalten beim Nukleolus sowie dem Kernsaft. In den folgenden Stadien der Kernteilung ist bei diesen keine Nukleal-Reaktion mehr wahrzunehmen. In karyotinreichen Kernen ist keine positive Reaktion des Nukleolus und des Kernsaftes von Anfang an zu beobachten. Nach den Resultaten von Kataphoresenzversuchen muss der Nukleolus elektrisch negativ geladen sein.

**125. Observaciones ad floram formosanam XIV-XV.** (With Japanese résumé). Yoshimatsu YAMAMOTO. (Jour. Soc. Trop. Agric. **8**, 1936, 264-284, 347-359, altogether 4 text-figs.).

Continuation of the author's study of Formosan plants in the American and European herbaria.

The articles cited in the above title contain besides a new variety, *Aster baccharoides* STEETZ var. *Kanchirai*, a large number of new combinations, all of which belong to the Compositae. The following genera are included: *Ainsliaea*, *Anaphalis*, *Aster*, *Bidens*, *Blumea*, *Carpesium*, *Centipeda*, *Cirsium*, *Dichrocephala*, *Gerbera*, *Gnaphalium*, *Eupatorium*, *Gynura*, *Ixeris*, *Lactuca*, *Mycelis*, *Crepidiastrum* and *Crepis*.

**126. Species nova mitrastemonacearum (Rafflesiacearum) ex Mexico.** (With Japanese résumé). Yoshimatsu YAMAMOTO. (Bot. Mag. Tôkyô **50**, 1936, 539-541, 7 text-figs., 582-583).

A description of a new Mexican species of *Mitrastemon*, *M. Matudai*.

**127. On the genus *Mitrastemon* MAKINO.** (Japanese). Yoshimatsu YAMAMOTO. (Bot. & Zool. **4**, 1936, 1667-1672, 1 col. pl. and 1 text-fig.).

The author gives at first the account of all species of *Mitrastemon* hitherto discovered in Japan, incl. Formosa. Then on the basis of the study on the temperature and the quantity of precipitation in various parts of Formosa he comes to the conclusion that during dry season (October to February of the next year), when the growth of host plants stops partially, *Mitrastemon* itself begins to develop suddenly, and produces flowers and fruits during a few months.

The distribution of various species of *Mitrastemon* in various parts of Japan is noticed.

**128. Index taihokensis III. (1935).** YAMAMOTO-Yosimatu, MASAMUNE-Genkei, SUZUKI-Sigeyosi, MORI-Kunihiko, HOSOKAWA-Takahide, FUKUYAMA-Noriaki. Publ. by Inst. of Systematic Botany and Plant Oecology, Fac. Sc. & Agric., Imp. Univ., Taihoku (Formosa), 1937, 60 pp.

Botanists of Taihoku Imp. Univ. began to publish the pamphlet of the above title, which contains the names of all newly discovered or newly named plants in Japan (incl. Formosa and Corea) and Manchuria. No. III just issued refers to plant names published in 1935. Each plant name (Latin) is accompanied by the Japanese name, place of its occurrence as well as literature.

**129. Ein haplo-diploides Zwillingspaar bei *Triticum vulgare* VILL.** (Mit japan. Zfg.). Yukio YAMAMOTO. (Bot. Mag. Tōkyō 50, 1936, 573-581, 588-589, 26 Textabb.).

Der Verf. hat ein haplo-diploides Zwillingspaar von *Triticum vulgare* bekommen. In den Zellen der Wurzelspitze bei der haploiden Pflanze hat er 21 Chromosomen gefunden. In der I. Metaphase der Reifungsteilung sind im allgemeinen 21 Univalente beobachtet, doch sind bisweilen 1-3 Bipartite gesehen (d.h. Chromosomenformel  $1_{II} + 20_I$ ,  $2_{II} + 17_I$  oder selten  $3_{II} + 15_I$ ), oder selten 1 Tripartite (d.h.  $1_{III} + 18_I$ ). Die Verteilung der Chromosomen nach den beiden Polen in der I. Anaphase geschieht nach dem Schema  $(1 + 1)^{21}$ , doch war die Zahl von  $(0 + 21)$  oder  $(1 + 20)$  bedeutend grösser als theoretisch zu erwartenden.

Ogleich oft das abnormale Verhalten der Chromosomen, wie die Regression oder Dreipoligkeit, angetroffen wurden, doch hat die Ausbildung der Pollentetraden aus den Pollenmutterzellen zumindest äusserlich ganz regelmässig stattgefunden. Unter 1000 Pollenkörnern sind bloss 7 normale vertreten. Die Ausbildung des haplodiploiden Zwillingspaares dürfte höchstwahrscheinlich darauf beruhen, dass die Befruchtung einer von beiden Synergiden und zugleich eine parthenogenetische Entwicklung der Eizelle geschehen sind.

**130. Über das Vorkommen von triploiden Pflanzen bei Mehrlingskeimlingen von *Triticum vulgare* VILL.** Yukio YAMAMOTO. (Cytologia 7, 1936, 431-436, 14 Textabb.).

Der Verf. hat bei *Triticum vulgare* einen aus zwei triploiden und einem diploiden Keimlingen bestehenden Drilling sowie einige je aus einem triploiden und diploiden Keimling bestehenden Zwillingen aufgefunden. Bei den erwachsenen Triploiden ist die Pflanzenhöhe niedriger und die Bestockung schwächer als bei den Diploiden, wegen die Blatt- und Blütenorgane sowie die Zellelemente der Blattepidermis (z.B. Epidermiszellen, Spaltöffnungen usw.) grösser bei den Triploiden als bei den Diploiden sind. Bei den Triploiden, deren Wurzelspitzenzelle 63 Chromosomen enthält, sind ausser den Uni- und Bivalenten eine mehr oder minder grosse Anzahl von Trivalenten vertreten. Hinsichtlich den Pollenkörnern scheinen  $\pm 30\%$  zumindest äusserlich ganz gesund zu sein, ebenso, ja sogar noch mehr die Embryosäcke. Die Bestäubung. Triploid  $\delta \times$  Diploid  $\sigma$  liefert 68.8% Körner in den 1. und 2. Blütenchen, die Selbstbestäubung 21.4% und die offene Bestäubung 25%. Die entgegengesetzte Bestäubung Diploid  $\delta \times$  Triploid  $\sigma$  die immer erfolglos.

**131. Reduktionsteilung von *Papaver somniferum* unter niederer Temperatur.** (Japanisch). Yosito YAMASAKI. (Proc. Crop Sc. Soc. Japan 8, 1936, 385-392, 6 Textabb.).

Die Blütenknospen von *Papaver somniferum*, zusammen mit einem kleinen Stücke des Blütenstieles, wurden während einigen Tagen der niederen Temperatur

ausgesetzt, z.B. 3–13°C, und die Meiose ihrer PMZ wurde untersucht. Dabei ist vor allem zu erwähnen, dass eine mehr oder minder grosse Zahl von Univalenten vertreten sind, welche entweder auf die Spindel unregelmässig zerstreut, oder in der Zellmitte angesammelt sind. Die Bivalenten sind dagegen dabei regelmässig auf dem Äquator gelagert. Die Univalenten gehen dann entweder als solche nach den Polen hinüber oder nicht selten erst nachdem sie aufgespalten sind. Die Dyaden sind oft ausgebildet, von denen die Chromosomenzahlen 11–11, 10–12, 9–13 usw. sind. Bisweilen wurde eine Gruppe von grossen PMZ angetroffen, von welchen jede die doppelte Chromosomenzahl enthält und woraus 4 Pollenkörner, je mit doppelter Chromosomenzahl, produziert wurden.

Noch einige andere Vorgänge, welche die doppelte Chromosomenzahl verursachen, sind erwähnt.

**132. Genetics and chromosome number in *Punica*.** (Japanese with English résumé) Kono YASUI. (Japan. Jour. Gen. **12**, 1936, 321–323, 1 text-figs.-group).

In *Punica granatum* and its variety *nana* the writer has identified three gene pairs concerning flower-colour, viz. Cc, Ss and Rr. R + C + S red, S + C pink, C alone no colour. 8 gemini are seen in both forms, and meiosis goes on normally.

**133. The anatomy of the embryo and the seedling of *Oryza sativa*, with special reference to the structure of cotyledon and mesocotyl in Gramineae.** (Japanese with English résumé). Kono YASUI. (Bot. Mag. Tôkyô **50**, 1936, 632–640, 11 text-figs.).

The morphological nature of scutellum and coleoptile in the Gramineae is yet the object of dispute among different authors. The writer of the present paper has studied the embryo and seedling of the rice plant in order to throw light on this problem. The general conclusions are as follows. The coleoptile is to be considered as the basal part of the cotyledon. The middle part of the latter which turns downwards immediately from the cotyledonary node forms together with the hypocotyl the mesocotyl, while the upper part which turns upwards from the point near the transition plate (= first node of seedling) forms the scutellum which covers the plumule, the coleoptile and the primary root, etc.

In the rice plant and others the scutellum trace (corresponding to the bundle of the cotyledon in its middle part) and the stele of hypocotyl run parallel as two separate bundles, while in *Zea Mays* they fuse together to form a compound mesocotyl stele.

Some authors (as AVERY) takes the scutellum for a part of the cotyledon, and consequently as a lateral structure, and the coleoptile as the terminal one. The writer agrees with AVERY concerning the first of the two opinions above mentioned, but not concerning the second, because the growing point of the plumule should be the terminal structure, but not the coleoptile.

**134. Cytogenetic studies in artificially raised interspecific hybrids of *Papaver* IV. Interspecific hybrids of *P. orientala* L. and *F. bracteata* LINDL.** Kono YASUI. (Cytologia **7**, 1936, 535–543, 1 pl. and 12 text-figs.).

*Papaver bracteata* is a diploid plant,  $2n = 14$ , and *P. orientale* a hexaploid,  $6n = 42$ . A plant got from a foreign source which is presumably the natural hybrid between the two above plants, was compared with the writer's artificial hybrid, *P. orientale*  $\times$  *P. bracteata* in respect to the chromosome behaviour during the meiosis of PMC. The similarity of this process in these two hybrids in general was ascertained. Both uni- and bivalents are seen, and besides the normal tetrads, irregular division leads to the formation, of several abnormal structures, such as diads, triads, extra-nuclear chromosomes, small pollen grains.



**135. Pathologic studies on rice blast caused by *Piricularia oryzae*. I. Some studies on the physiology of the pathogene.-II. On the mode of infection of the pathogene.** (Japanese with English résumé). Hazime YOSHII. (Ann. Phytopathol. Soc. Japan **6**, 1936, 199-204, 205-218, 1 pl. and 15 text-figs.).

The following experimental results were got on the culture of *Piricularia oryzae*. This fungus cannot grow under anaerobic condition. Optimum temperature for its growth  $\pm 28^{\circ}\text{C}$ . Nitrate is not reduced, and nitrite seems to be injurious. As C-source glucose, starch, pectic substances may be mentioned. Oxydase and dehydrase were detected.

The fungus infects young blades first by forming appressoria on them, and then by piercing through the outer membrane of epidermal cells which are not very much silicified it enters them. In this case stomatal as well as accessory cells are the structures which are easily affected. When the infection takes place at the base of the ear, the fungus can enter the host cell just as in the young blade, though with some difficulty.

During the infection a slender penetration hypha is produced in the undersurface of the appressorium, and the hypha enters the epidermal cell by piercing through its cell membrane. The hypha, as soon as it reaches the inside of the cell-membrane, forms there a small vesicle, which will convert itself into vegetative hyphae or from which they will branch out.

**136. Einfluss der Sonnenfinsternis auf die Pflanzen.** (Japanisch). Yoshiji YOSHII. (Oekolog. Studien **2**, 1936, 261-276, 6 Textabb.).

Eine totale Sonnenfinsternis war am 19. Juni 1936 in gewissen Gegenden Hokkaidô zu beobachten. In Sendai, Wohnorte Verf., wo sie bloss partiell (0,85) war, hat er einige Versuche unternommen, um den Einfluss derselben auf den Vorgang der Kohlen-säure-Assimilation kennenzulernen. Dabei wurde vor allem festgestellt, dass die Schwankung der Assimilationsintensität (an den von den Laubblättern aufgenommenen  $\text{CO}_2$ -Menge gemessen) fast parallel zu derselben der Gesamtstrahlung der Sonne geht. Schon 1 Stunde nach dem Eintritt der Finsternis fängt die Assimilations-intensität plötzlich sich zu erniedrigen an, und  $\frac{1}{2}$  Stunde vor oder nach dem Maximum der Finsternis, wobei die Gesamtstrahlung bloss  $0,075 \text{ g kal. min. cm}^2$  beträgt, zeigt die Assimilationsintensität einen negativen Wert, was bedeutet, dass der Assimilations-vorgang völlig sistiert und der Erfolg der Atmung auffallend wird. Es wurde weiter beobachtet, dass die Transpirationsintensität auch erniedrigt wird, und zwar um etwas  $\frac{1}{2}$  Stunde verzögert. Es ist klar, dass dies Phänomen mit der Schliessbewegung der Spaltöffnungen in enger Beziehung steht.

**137. FEULGEN's nucleal staining applied to Pteridophyta.** Akira YUASA. (Proc. Imp. Acad. **12**, 1936, 266-268).

A certain number of plants belonging to various families of Filicineae, as well as those belonging to the Equisetaceae, Lycopodiaceae, Selaginellaceae, Psilotaceae and Isoetaceae were examined concerning the nucleal reaction of nuclei. It was found that in the greater majority of cases the reaction was positive, though few instances of negative reaction were met with. The latter fact might be due to the presence of a too small quantity of thymonucleic acid in nuclei. The nucleoli were almost always FEULGEN-negative, except some few cases (karyosome-nucleoli).

The nuclei of spermatozoa were also tested, and the results of the former observations of the author were confirmed in the main.

## Inheritance in rice, *Oryza sativa* L.<sup>(1)</sup>

### II. Linkage between the gene for purple plant colour and the gene for liguleless<sup>(2)</sup>

By Toshitaro MORINAGA

(Received December 15, 1937)

*Oryza sativa* L. contains a large number of cultivated varieties, and the morphological and physiological characters involved in their distinguishing marks are very numerous. Moreover, as a by-product of recent extensive breeding projects many kinds of useless mutant forms have been disclosed. Thus the species may rightly be regarded, for its richness in genes, as one of the most suitable objects for genetic study. Owing to the efforts of many rice breeders in Japan and India, and also of some genetists having special interest in the species, the genetical nature of quite a number of heritable characters have been investigated. According to the chromosome theory, the genes in *Oryza sativa* L. should be arranged in twelve associated groups. The studies, however, are still fairly backward in this respect. Excepting the cases of complete or nearly complete association, only the following may be cited as clear instances of linked genes:

- a. The gene for glutinous endosperm and a gene for red apiculus or awn (1, 3 and 4).
- b. The gene for glutinous endosperm and the gene for tawny apiculus and empty glumes (1).
- c. The gene for glutinous endosperm and a gene for heading time (5).
- d. A gene for red apiculus and a gene for heading time (5).
- e. A gene for purple stigma and a gene for purple leaf-sheath (1).
- f. A gene for ripening black inner glumes and a gene for purple lined internode (2).

In the present report, the author describes a new case of partial linkage between a pigment distribution gene and the gene for liguleless character.

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(1) Contributions from the Institute of Agronomy, Kyushu Imperial University, No. 59.

(2) The No. 1 of this series was published under the title "The chlorophyll deficiencies in rice" in Botanical Magazine Tokyo, Vol. XLVI, No. 544 (1932).

## Materials

In 1934, a purple mutant form 'Murasaki-higeyorikawari' was crossed to a liguleless form 'Murasaki-muyozetuto', and the  $F_1$  plant was raised in the following year. It was in the  $F_2$  generation of this hybrid that a clear partial association of certain genes was noticed. The main characteristics of those parental forms are as follows:

**Murasaki-muyozetuto:** The awn, empty glumes and the stigma are purple. The leaf-sheath shows purple colour inside near the base, often revealing light purple lines outside. The leaf-blade is wholly green. No ligules and auricles develop. The young plant of this form looks, at a glance, like a wholly green one. **Murasaki-higeyorikawari:** A wholly purple form with the awn. It produces normal ligules and auricles, but the panicles are extraordinarily lax.

## $F_1$ generation

So far as the plant colour system is concerned, the  $F_1$  plant closely resembled Murasaki-higeyorikawari, and produced normal ligules and auricles. The panicles of the  $F_1$  were normal like those of Murasaki-muyozetuto. The characters of the  $F_1$  and the parental forms are compared in Table I.

TABLE I  
Comparison of the parental forms and the  $F_1$  plant.

	Ligule and auricle	Colour									Density of ear	Number of tiller
		Ligule	leaf-sheath	leaf-blade	inter-node	node	awn	stigma	glumes	empty glumes		
Murasaki-muyozetuto	with-out	—	outside, often shows light purple line inside, purple near the base	both sides green	green	green	purple	purple	green	purple	normal	normal
Murasaki-higeyorikawari	with	purple	both sides purple full colour	both sides purple	sun-purple	sun-purple	purple	purple	purple	purple	vary lax	few
The F <sub>1</sub>	with	purple	both sides purple full colour	both sides purple	sun-purple	sun-purple	purple	purple	purple	purple	normal	few

**F<sub>2</sub> generation**

In the spring of 1936, nearly one half of the F<sub>2</sub> seeds were sown in the usual manner, and the seedlings produced were examined carefully when they were transplanted. The seedling population consisted of four distinct types. One type was wholly purple with ligules, and another was green without them. Of the two new types, one was purple without ligules and the other was green with them. The segregation, purple versus green, and with ligule versus liguleless showed respectively a simple Mendelian ratio 3:1. The ratio of the four types above mentioned, however, deviated very widely from the expectation on the basis of independent assortment. The remaining F<sub>2</sub> seeds were sown in July to duplicate the investigation. The results are summarized in Table II.

TABLE II

The F<sub>2</sub> segregation of the cross Murasaki-muyozetuto ♀ × Murasaki-higeyorikawari ♂

Types		Purple plant with ligules	Purple plant without ligules	Green plant with ligules	Green plant without ligules	Total
Observed number	1st exp.	152	16	19	34	221
	2nd exp.	161	24	30	40	255
	Total	313	40	49	74	476
Expected number on the basis of 21% crossover		312.58	44.42	44.42	74.58	476
Deviation		+0.42	-4.42	+4.58	-0.58	$\chi^2 = 0.9216$

The plant colour purple versus green leaves no room for doubt as to one allelomorphic pair of characters, while with-ligules versus liguleless makes another pair. Thus the factor responsible for purple plants is designated by  $P_l$  and that for green plants by  $p_l$ , so also the factor for ligules by  $L_g$  and for the liguleless by  $l_g$ . The F<sub>2</sub> distribution of the four types given in Table II suggests a fairly strong coupling of  $P_l$  and  $L_g$  factors. The cross-over value obtained by the product ratio method was 21 percent, and the expected frequencies of the four types calculated on that basis agreed closely with the observed ones. The green seedling produced an adult plant having the same system of colour distribution as seen in Murasaki-muyozetuto. The purple seedling, on the other hand, produced a plant, as far as the colour was concerned, closely resembling Murasaki-higeyorikawari.



In the  $F_2$  population, a high negative correlation ( $r = -0.707$ ) between the plant colour and the capacity of tillering was noticed. This tendency of association, however, may be taken as of a physiological nature rather than a genetical. The density of the panicle normal and lax revealed as a simple Mendelian pair, the normal being dominant. These characters segregated independently with the colour as well as the liguleless character.

### $F_3$ generation

In the winter of 1936 and in the spring following, the  $F_3$  progenies of 206  $F_2$  individuals were raised to inquire more closely concerning the  $P_1$ - $L_g$  linkage above mentioned. Of those 206  $F_3$  lines, 36 composed of less than 50 individuals, and 5, of which segregation ratios suggested some error caused by seed mixing, were discarded, leaving 165 lines to trace back their  $F_2$  genotypes. The results in detail are presented at the end of the paper (p. 127 ff.).

As one of the parents, i.e. Murasaki-muyozetuto, is represented by the formula  $(p_l l_g)$   $(p_l l_g)$ , and the other, Murasaki-higeyorikawari, by  $(P_l L_g)$   $(P_l L_g)$ , the formula for the  $F_1$  plant must be  $(p_l l_g)$   $(P_l L_g)$ . In the  $F_2$  generation ten sorts of genotypes, namely  $(P_l L_g)$   $(P_l L_g)$ ,  $(P_l L_g)$   $(p_l l_g)$ ,  $(P_l L_g)$   $(p_l L_g)$ ,  $(P_l L_g)$   $(P_l l_g)$ ,  $(P_l l_g)$   $(p_l l_g)$ ,  $(P_l l_g)$   $(p_l L_g)$ ,  $(p_l L_g)$   $(p_l l_g)$ ,  $(p_l L_g)$   $(P_l l_g)$ ,  $(p_l l_g)$   $(P_l L_g)$  and  $(p_l l_g)$   $(p_l l_g)$  are

TABLE III  
The frequency distribution of the 10  $F_2$  genotypes of the cross  
Murasaki-muyozetuto  $\times$  Murasaki-higeyorikawari.

$F_2$ genotype	Observed frequencies	Expected frequencies on the basis of 21% cross over	Deviation	Standard deviation
$(P_l L_g)$ $(P_l L_g)$	27	25.74	+1.26	4.66
$(P_l L_g)$ $(p_l l_g)$	12	13.68	-1.68	3.54
$(P_l L_g)$ $(p_l L_g)$	17	13.68	+3.32	3.54
$(P_l L_g)$ $(P_l l_g)$	45	51.49	-6.49	5.95
$(P_l l_g)$ $(p_l L_g)$	6	3.64	+2.36	1.89
$(P_l l_g)$ $(p_l l_g)$	8	13.68	-5.68	3.54
$(p_l L_g)$ $(p_l l_g)$	17	13.68	+3.32	3.54
$(p_l L_g)$ $(P_l L_g)$	0	1.82	-1.82	1.34
$(P_l l_g)$ $(P_l l_g)$	1	1.82	-0.82	1.34
$(p_l l_g)$ $(P_l l_g)$	32	25.74	+6.26	4.66
Total	165	165.01	—	—

expected in a certain proportion which is causally dependent on the linkage value of  $P_l I_{og}$ . Table III is compiled to compare the actual frequencies of those genotypes with the frequencies calculated on the basis of 21 percent cross-over.

The corresponding frequencies observed and calculated agreed fairly closely for such a comparatively small total number.

Again the  $P_l-I_{og}$  linkage was ascertained in another way investigating the frequency distributions of the four phenotypes  $P_l I_{og}$ ,  $P_l l_{og}$ ,  $p_l I_{og}$  and  $p_l l_{og}$  in the 45  $F_3$  lines of coupling phase, and the 6  $F_3$  lines of recombination. Summing up the lines of coupling and repulsion respectively, Table IV and V were compiled.

TABLE IV

The frequency distributions of the four phenotypes in the  $F_3$  lines showing coupling phase

Types	Purple plant with ligules	Purple plant without ligules	Green plant with ligules	Green plant without ligules	Total
Observed numbers, total of the 45 lines	8587	1241	1309	2012	13149
Expected number on the basis of 22% cross-over	8574.46	1287.29	1287.29	1999.96	13149
Deviation	+12.54	-46.29	+21.71	+12.04	$\chi^2 = 2.1770$

TABLE V

The frequency distributions of the four phenotypes in the  $F_3$  lines showing repulsion phase

Types	Purple plant with ligules	Purple plant without ligules	Green plant with ligules	Green plant without ligules	Total
Observed numbers, total of the 6 lines	1190	510	560	39	2299
Expected number on the basis of 26% cross-over	1188.35	535.90	535.90	38.85	2296
Deviation	+1.65	-25.90	+24.10	+0.15	$\chi^2 = 2.3556$

For the coupling phase, the cross-over value calculated by the product ratio method was 22 percent, while the value for the repulsion phase was 26 percent.

### Remarks

The  $F_2$  and  $F_3$  segregation data presented above demonstrated clearly that the gene for full purple leaf colour  $P_l$  links imperfectly with the gene for ligules  $L_g$ , showing 21–22 percent of recombination. In rice, the linkage phenomena have been studied best between the genes for glutinous endosperm and red apiculus. The gene for tawny apiculus and that for heading time fall into this linkage group. From the breeding experiments, which are not included in this report, the gene  $L_g$  is proved to be independent of the gene for red apiculus. For the production of full purple leaf colour simultaneous presence of  $P_l$  and certain fundamental colour genes responsible for apiculus colour, is necessary. The effect of  $P_l$  is observable chiefly in the distribution of the colour over the leaf. Full discussion will be given at another opportunity.

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## (1) Dihybrid segregation (coupling phase)

F <sub>2</sub> ind. No.	F <sub>2</sub> Phenotype	F <sub>3</sub> phenotypic segregation				Total
		P <sub>l</sub> L <sub>g</sub>	P <sub>l</sub> l <sub>g</sub>	p <sub>l</sub> L <sub>g</sub>	p <sub>l</sub> l <sub>g</sub>	
1	P <sub>l</sub> L <sub>g</sub>	321	48	59	101	529
2	" "	138	18	36	41	233
7	" "	63	11	3	17	94
8	" "	256	39	45	49	389
19	" "	211	34	30	59	334
29	" "	302	49	42	71	464
30	" "	221	31	36	46	334
31	" "	330	57	55	102	544
41	" "	90	7	15	29	141
49	" "	179	14	27	36	256
52	" "	59	19	7	7	92
56	" "	243	36	33	57	374
61	" "	237	34	38	77	436
65	" "	82	5	12	24	123
69	" "	329	44	43	74	490
71	" "	99	14	16	14	143
77	" "	46	5	3	9	63
87	" "	111	13	19	27	170
93	" "	179	17	24	32	252
97	" "	143	16	23	33	215
100	" "	209	29	34	73	345
104	" "	90	8	12	15	125
105	" "	372	59	40	102	573
106	" "	141	18	23	30	212
109	" "	325	48	59	69	501
112	" "	261	73	62	97	593
124	" "	39	9	0	9	57
126	" "	217	28	33	40	318
127	" "	143	24	18	33	218
141	" "	258	45	34	60	397
142	" "	35	3	9	5	52
144	" "	180	17	47	24	268
146	" "	244	30	32	52	358
157	" "	216	30	33	42	321
163	" "	235	36	34	56	361
169	" "	97	19	17	24	157
176	" "	43	7	4	18	72
181	" "	436	62	67	88	653
183	" "	372	66	46	84	568
185	" "	50	7	8	7	72
187	" "	210	37	25	47	319
188	" "	58	6	14	9	87
191	" "	158	21	30	34	243
197	" "	39	4	9	13	65
203	" "	365	44	53	76	538
Total .....		8587	1241	1309	2012	13149



## (2) Dihybrid segregation (repulsion phase)

F <sub>2</sub> ind. No.	F <sub>2</sub> Phenotype	F <sub>3</sub> phenotypic segregation				Total
		<i>P<sub>l</sub> L<sub>g</sub></i>	<i>P<sub>l</sub> l<sub>g</sub></i>	<i>p<sub>l</sub> L<sub>g</sub></i>	<i>p<sub>l</sub> l<sub>g</sub></i>	
9	<i>P<sub>l</sub> L<sub>g</sub></i>	298	140	134	14	586
32	" "	60	25	23	0	108
33	" "	165	63	86	3	317
115	" "	227	100	120	4	451
164	" "	173	63	69	4	309
189	" "	267	119	128	14	528
Total .....		1190	510	560	39	2299

(3) Segregation of *L<sub>g</sub> l<sub>g</sub>* in purple plant.

F <sub>2</sub> ind. No.	F <sub>2</sub> Phenotype	F <sub>3</sub> Phenotypic segregation		Total
		<i>L<sub>g</sub></i>	<i>l<sub>g</sub></i>	
18	<i>P<sub>l</sub> L<sub>g</sub></i>	84	34	118
67	" "	56	26	82
78	" "	240	82	322
114	" "	173	47	220
116	" "	234	75	309
125	" "	103	38	141
135	" "	67	30	97
139	" "	47	10	57
170	" "	260	76	336
172	" "	224	84	308
175	" "	306	98	404
179	" "	66	26	92
Total .....		1860	626	2486

(4) Segregation of *L<sub>g</sub> l<sub>g</sub>* in green plant.

F <sub>2</sub> ind. No.	F <sub>2</sub> Phenotype	F <sub>3</sub> Phenotypic segregation		Total
		<i>L<sub>g</sub></i>	<i>l<sub>g</sub></i>	
3	<i>p<sub>l</sub> L<sub>g</sub></i>	67	20	87
4	" "	583	219	802
5	" "	597	210	807
47	" "	579	168	747
62	" "	955	376	1331
80	" "	66	19	85
81	" "	656	261	917
82	" "	142	44	186
84	" "	651	206	857
94	" "	81	24	105
117	" "	315	112	427
123	" "	554	163	717
143	" "	693	245	938
152	" "	788	260	1048
158	" "	1086	358	1444
195	" "	1025	326	1351
198	" "	217	84	301
Total .....		9055	3095	12150

(5) Segregation of  $P_l p_l$  in Liguled plant.

F <sub>2</sub> ind. No.	F <sub>2</sub> Phenotype	F <sub>3</sub> Phenotypic segregation		Total
		$P_l$	$p_l$	
11	$P_l L_g$	573	213	786
22	" "	251	72	323
27	" "	314	111	425
68	" "	43	12	55
95	" "	284	104	388
98	" "	196	59	255
102	" "	391	148	539
107	" "	290	77	367
111	" "	93	25	118
133	" "	81	26	107
138	" "	237	80	317
171	" "	272	86	358
173	" "	308	113	421
180	" "	65	17	82
186	" "	270	102	372
193	" "	276	82	358
205	" "	430	146	576
Total .....		4347	1473	5847

(6) Segregation of  $P_l p_l$  in Liguleles plant.

F <sub>2</sub> ind. No.	F <sub>2</sub> Phenotype	F <sub>3</sub> Phenotypic segregation		Total
		$P_l$	$p_l$	
6	$P_l l_g$	125	31	156
25	" "	146	60	206
42	" "	93	28	121
66	" "	53	13	66
73	" "	161	40	201
120	" "	321	107	428
155	" "	189	71	260
159	" "	152	54	206
Total .....		1240	404	1644



# Beeinflussung der Spaltöffnungsweite durch Regenfall

Von Masami MONZI

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Mit 3 Textfiguren

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(Eingegangen am 22. Dezember 1937)

Überall in Japan fallen viel grössere Regenmengen zugleich mit weit grösserer Regenhäufigkeit als in europäischen und nordamerikanischen Ländern. Daher ist es von vornherein klar, dass die Beeinflussung der Spaltweite durch Regenfall bei uns besonders bedeutungsvoll sein kann.

Die Beziehungen zwischen der Spaltweite und dem Regenfall sind aber bis jetzt fast unberücksichtigt geblieben, weshalb ich mir mit der vorliegenden Arbeit darüber einige Anhaltspunkte zu gewinnen vornahm. Ich habe zuerst die Stomabewegungen sowohl während der Regenzeit als auch nach dem Aufhören des Regens beobachtet, ferner durch Versuche den Einfluss der mechanischen, photischen, thermischen und hydrischen Faktoren auf die Spaltweite untersucht.

Vorliegende Untersuchungen wurden unter der Leitung und Anregung von Herrn Professor Dr. H. NAKANO ausgeführt, so dass ich ihm für seine Hilfe und Ratschläge zum herzlichsten Dank schuldig bin.

## I. Methodik und Versuchsmaterial

Bei den vorliegenden Untersuchungen gebrauchte ich die Infiltrationsmethode sowohl im Freien, als auch im Laboratorium. Als Infiltrationsflüssigkeiten dienten mir Äther, Petroläther, Xylol, Benzol, Alkohol und Paraffinöl, von welchen Äther am leichtesten und die anderen der Reihe nach immer schwerer eindringen. Abschätzungsweise habe ich dabei die Grade der Infiltration nach der Geschwindigkeit des Eindringens und dem Infiltrationszustand in 5 Klassen unterschieden.

Klasse	Bezeichnungs- zahl	Infiltrations- geschwindigkeit	Infiltrations- zustand
Sehr schwer	1	nach 10 Sekunden oder länger Zeit	fleckenweise
Schwer	2	„	über die ganze Fläche
Mässig	3	in einigen Sekunden	„
Leicht	4	in wenigen Sekunden	„
Sehr leicht	5	augenblicklich	„



Den Gesamtbetrag der Bezeichnungszahlen für alle sechs Flüssigkeiten nenne ich die „Infiltrationszahl“, und damit kann ich den Öffnungsgrad der Stomata qualitativ, aber fast quantitativ, sehr leicht bezeichnen. Um den zeitlichen Wechsel der Spaltweite graphisch darzustellen, zeichnete ich die Infiltrationszahl-Zeit-Kurve.

Als Versuchsmaterial gebrauchte ich das Lichtblatt der in Japan einheimischen Art, *Fatsia japonica* DECNE. et PLANCH. Ihre Blattspreite ist gross und handförmig, und auf deren Unterseite finden sich etwa 200 Stomata auf 1 qmm, aber die ganze Oberseite, mit alleiniger Ausnahme einer schmalen Zone längs der Nerven, ist stomatafrei.

Bei tagsüber klarem Wetter pflegte ich die Untersuchungen auszuführen, da zu derselben Zeit eine geeignete Temperatur im Gewächshause oder Versuchszimmer und eine geringe Schwankung der Lichtintensität zu erwarten sind. Morgens entnahme ich die noch im Schatten gehaltenen Lichtblätter der im Freien wachsenden *Fatsia*-Pflanzen, wobei ich die Blattstiel derselben unter Wasser abschnitt. Das so abgeschnittene Blatt wurde an seinem Stielende in ein besonderes Wassergefäss gesteckt, danach bald in das Gewächshaus gebracht, und in diffusum Licht horizontal gelegt. Nun bestimmte ich die Spaltweite mit einem frisch abgeschnittenen Blattstück. Um individuelle Verschiedenheit der Reaktion zu eliminieren, habe ich für ein und denselben Versuch vier Versuchs- und drei Kontrollblätter gebraucht. Nach etwa einer Stunde setzte ich die Blätter dem künstlichen Regen aus, den ich dadurch erzielte, dass ich eine Brause mit Wasserhahn, bisweilen, um warmes Regenwasser zu gewinnen, mit einem Wasserkessel in Verbindung brachte. Wenn die Blattunterseite dabei durchnässt wurde, wurde der Versuch erst nach leichtem Abwischen mit einem Stückchen trocknen Tuchs oder Filtrierpapiers begonnen. Zur Bestimmung der Lufttemperatur und -feuchtigkeit im künstlichen Regen wendete ich einen mit Glasglocke bedeckten Psychrometer an. Nach einstündiger Wasserbegiessung habe ich innegehalten, um die Nachwirkung des Regens auf die Spaltweite zu erforschen.

## II. Täglicher Wechsel der Spaltöffnungsweite im Freien

Als Vorversuche habe ich im Okt. 1936 den täglichen Wechsel der Spaltweite von einigen Pflanzen, nämlich *Fatsia japonica*, *Erigeron annuus*, *Ricinus communis*, *Cornus controversa*, *Pollia japonica* und *Camellia japonica*, im Freien erforscht. Bei *Fatsia* stellte ich mit dem Licht- und Schattenblatt, bei *Erigeron* mit rosettenartigem Lichtblatt, bei *Ricinus* mit Lichtblatt und bei *Cornus*, *Pollia* und *Camellia* nur mit Schattenblatt meine Versuche an. Die Blätter von *Fatsia*, *Erigeron* und *Ricinus* sind amphistomatisch, dagegen sind die von *Cornus*, *Pollia* und *Camellia* hypo-

stomatisch. Die Versuche wurden bei *Erigeron* auf beiden Blattoberflächen, bei anderen Arten aber auf den Unterseiten vorgenommen. Die Stomata von diesen sechs Arten bewegen sich im Wesentlichen fast in gleicher Weise, wenn die Blätter und die Stomata auch anatomisch voneinander ziemlich verschieden sind. Am Morgen des 26. war es trüb, und die Spalten öffneten sich mässig weit, aber mit Regen am Nachmittag setzte eine Schliessbewegung ein. Am folgenden Tag wurde es heiter um 9 Uhr, und durch den strahlenden Sonnenschein wurde um 14 Uhr mit 30% das Minimum der Luftfeuchtigkeit, und die maximale Temperatur von 22°C erzeugt. Die Stomata, die morgens weit geöffnet waren, begannen schon am Vormittag sich zu schliessen. Auch am 28. war es heiter den ganzen Tag hindurch, aber infolge der Unklarheit der Luft hatten wir schwächeres Sonnenlicht, höhere Luftfeuchtigkeit und niedrigere Temperatur als am vorgehenden Tag. Um 11 Uhr des 29. bewölkte sich aber der Himmel, und die minimale Feuchtigkeit betrug etwa 70%, die maximale Temperatur 16°C. An diesen zwei Tagen bewegten sich die Stomata ganz gleichartig: die Weiten derselben erreichten ihre Maxima zwischen 10 und 12 Uhr. Der Regen, der in der Mitternacht angefangen hatte, hörte gegen 9 Uhr am 30. auf, und darauf blieb es bis zum Abend bewölkt. Die Spalten erweiterten sich an diesem Tag so allmählich, dass die grössten Öffnungen erst zwischen 12 und 14 Uhr vorlagen.

Am 19. und 20. Nov. 1936 stellte ich abermals im Freien mit dem Blatt von *Fatsia* Versuche an. Am 19. regnete es den ganzen Tag über. Die Spalten öffneten sich langsam, und gegen 15 Uhr blieben sie noch ziemlich weit geöffnet. Aber am folgenden Tag war es sehr klar, und gegen Mittag zeigten sie sich mit der maximalen Öffnung, dann schlossen sie sich rasch zu. So war sowohl beim Lichtblatt als auch beim Schattenblatt die Infiltrationszahl grösser an dem heiteren Tag als an einem Regentag.

Auf Grund der oben erwähnten Untersuchungen kann ich behaupten, dass die Stomata unserer Versuchspflanzen zur Regenzeit nur bis zu einer schmäleren Weite als zur klaren sich öffnen können, und dass das Maximum der Spaltweite sich an feuchten Tagen später als an trocknen einstellt, wie es schon von LOFTFIELD (1921) und als Schlechtwettertypus von WEBER (1923) klar gestellt wurde.

### III. Versuche im Laboratorium mit künstlichem Regen

Da die oekologischen Bedingungen im Freien zu verwickelt sind, um die Beeinflussung der Spaltweite durch Regenfall genau und ausführlich zu untersuchen, habe ich einige Versuche mit künstlichem Regen vor-

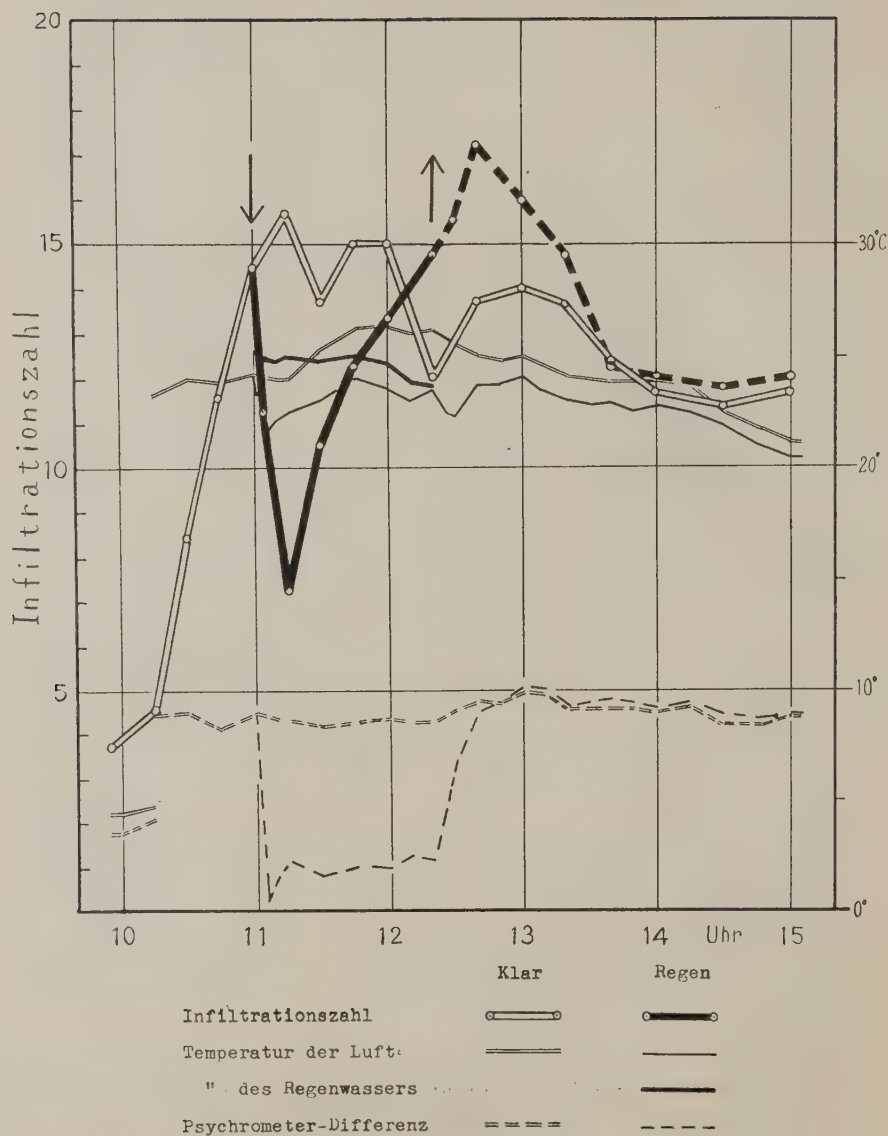


Fig. 1. Beeinflussung der Spaltweite des frischen Lichtblattes von *Fatsia* durch künstlichen Regenfall. Abwärtsgerichteter Pfeil: Anfang des Regens. Aufgerichteter Pfeil: Aufhören des Regens.

genommen, um damit die Forschung unter einer bestimmten Bedingung zu erleichtern.

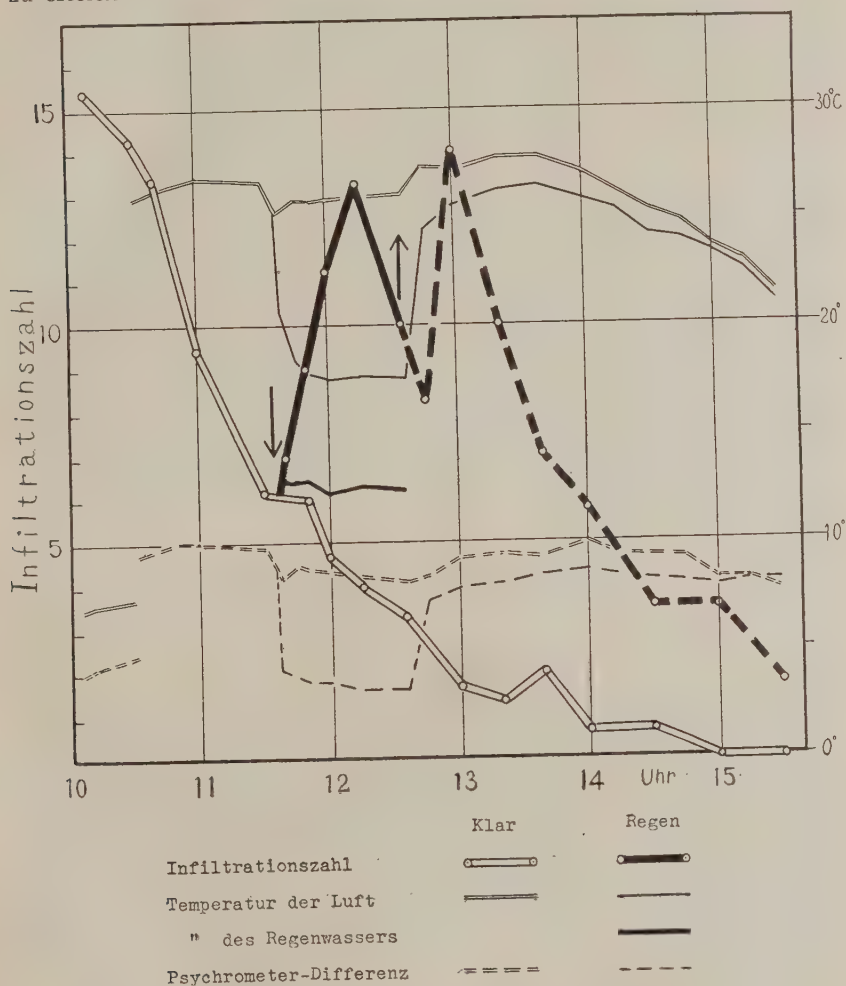


Fig. 2. Beeinflussung der Spaltweite des welken Lichtblattes von *Fatsia* durch künstlichen Regenfall. Abwärtsgerichteter Pfeil: Anfang des Regens. Aufgerichteter Pfeil: Aufhören des Regens.

### (1) Mit einem frischen Blatt

Wenn man die Schnittfläche des Blattstiels von *Fatsia* in einem mit Wasser gefüllten Gefäß stehen lässt, so bleibt die Blattspreite lange Zeit



bis zum Ende des Versuchs frisch. Die Stomata von diesem Versuchsblatt bewegen sich normal und zeigen die maximale Weite, wie ich schon beim Versuch im Freien gesagt habe, gegen Mittag. Um einen grossen Stomawechsel zu erhalten, wurden die Versuchsblätter, die maximale oder ähnliche Spaltweite aufweisen sollen, dem künstlichen Regen ausgesetzt.

Am 14. Jan. 1937, einem klaren Wetter, habe ich einen Versuch gemacht. Die Ergebnisse dieses Versuchs sind in Fig. 1 gezeigt.

Am 16., 27. und 29. Dez. 1936 wiederholte ich dieselben Untersuchungen mit einem künstlichen Regen von etwa 10°C geringerer Temperatur als die Luft, und am 15. Jan. 1937 mit einem beinahe um 6°C wärmeren. Trotzdem die Regentemperatur dabei sehr verschieden war, haben die Stomata auf den Regenfall in völlig gleicher Weise reagiert, wie bei dem oben angegebenen Versuch. D.h. sobald es zu regnen anfängt, geht eine schnelle Schliessbewegung in den weit geöffneten Stomata vor sich, aber nachdem sie die minimale Weite innerhalb der nächsten 15 Minuten erreichen, öffnen sie sich wieder langsam. Wenn es zu regnen aufgehört hat, weiten sie sich rasch aus. Nach einiger Zeit tritt eine neue Verengung der Spalten auf, aber es ist gewöhnlich, dass die Stomata des dem Regen ausgesetzten Blattes noch lange Zeit weiter als die des Kontrollblattes offen bleiben.

## (2) Mit einem welken Blatt

Um mit dem obigen Resultat einen Vergleich zu ziehen, habe ich sodann einen weiteren Versuch mit welken Blättern am 30. Dez. 1936 (klares Wetter) ausgeführt. Die dabei erhaltene Spaltöffnungsbewegung ist in Fig. 2 graphisch dargestellt.

Aus diesem Ergebnisse ist ersichtlich, dass Regen im Gegensatz zum frischen auf die geschlossenen Stomata des welken Blattes zuerst als Erweiterungsmittel wirkt, wie es bereits früher von ILJIN (1933) klar gestellt wurde, wenngleich eine neue Schliessbewegung schon nach etwa einer halben Stunde in die Erscheinung tritt. Aber auch beim welken Blatt ist die Nachwirkung des Regens dieselbe, wie bei dem frischen Blatt, d.h. hat es aufgehört zu regnen, so beginnen die Spalten noch einmal sich zu öffnen, und die so erreichte maximale Öffnung beginnt dann wieder plötzlich abzunehmen.

## IV. Die Ursache der durch Regenfall erregten Spaltöffnungsbewegung

Da Regenfall ein Komplex von mechanischen, photischen, thermischen und hydrischen Faktoren ist, so wäre es unbedingt erforderlich zu bestimmen, welcher Faktor des Regenfalls die Spaltweite hauptsächlich beeinflusse.

### (1) Regen als mechanischer Faktor

Über die mechanische Wirkung des Regens auf Pflanzen, doch nicht auf deren Stomata, hat WIESNER schon im Jahre 1897 untersucht, und er zog den Schluss, dass Regen auf Pflanzen mechanisch keine merkliche Einwirkung ausüben kann. Aber anderseits hat KNIGHT (1916) berichtet, dass blosses Klopfen oder Erschütterung von einigen Blättern das Schliessen der Stomata hervorbringe.

Mit Kies-Regen habe ich am 17. April, 1937 einen Versuch über dieses Problem gemacht. Das Gewicht eines Kieskorns betrug durchschnittlich 0,33 g, und die Fallgeschwindigkeit nahe dem Blatt 4m/sec, also ihre lebende Kraft etwa 26400 Ergs. Etwa 8 Körner fielen in einer Minute auf 1 qcm. Der Kies-Regen dauerte 20 Minuten lang an, aber als Folge desselben vermochte ich keine Beeinflussung der Spalten wahrzunehmen. In der Natur beträgt die lebende Kraft eines gewöhnlichen Regenschauers nicht über 22500 Ergs (MÜLLER, 1936, S. 181). Also darf man schliessen, dass die Stomata des Blattes von *Fatsia* von natürlichem gewöhnlichem Regen mechanisch kaum beeinflusst werden.

Der Tropfen des von mir bereiteten künstlichen Regens hatte 0,6 mm Durchmesser und eine Geschwindigkeit von 4,5 m/sec, und die Regenmenge belief sich auf beinahe 6 mm/min. Die mechanische Wirkungsfähigkeit des künstlichen Regens ist also so beträchtlich geringer als die des Kies-Regens, dass seine mechanische Wirkung bei meinem Versuch kaum in Betracht kommt.

### (2) Regen als photischer Faktor

Wenn man das Blatt von *Fatsia* aus einem hellen Zimmer in die stockfinstere Dunkelkammer bringt, so beginnen die Stomata sich zu schliessen, aber die dabei vor sich gehende Schliessbewegung ist viel langsamer, als dass man allein mit der Lichtschwächung den durch Regenfall verursachten Spaltverschluss erklären könnte. Weiter ist die der anfänglichen Schliessung folgende Öffnung der Spalten, die beim frischen Blatt zur Regenzeit auftritt, und die erste rasche Öffnung, die beim welken Blatt mit Anfang des Regens sich einstellt, gar nicht auf Lichtschwächung zurückzuführen.

Im Jahre 1925 berichtete aber NIKOLIĆ über den kurzfristigen Stomaverschluss, der durch plötzliche Zu- oder Abnahme der Lichtintensität herbeigeführt wird. Wäre der Wechsel der Lichtintensität die Ursache der eigentümlichen Stomabewegung zur Regenzeit, so müsste mit dem Aufhören des Regens eine neue Schliessbewegung eintreten; in Wirklichkeit gelang aber es nicht dieselbe in meinen Versuchen zu finden.

Anderseits hat LOFTFIELD (1921) erwähnt, dass die Lichtintensität, die um etwas über die Hälfte der normalen herabgesetzt wurde, erst einen

Einfluss auf die Spaltweite ausüben kann. Dieser Fall ist bei Regenfall im Freien möglich, aber nie bei meinen oben erwähnten künstlichen Regen, weil eine beträchtliche Abnahme der Lichtintensität im letzteren Fall nicht zu erwarten ist.

Jedenfalls ist es schwer, eine allgemein gültige Beziehung zwischen der Stomabewegung und Lichtschwankung während der Regenzeit zu finden.

### (3) Regen als thermischer Faktor

STALFELT (1928) und BELJAKOFF (1929) haben berichtet, dass die Bewegungen der Schliesszellen von *Vicia*- und Gerstenblättern keine Abhängigkeit von Temperaturveränderungen zeigen. Auch beim *Fatsia*-Blatt fand ich dasselbe Verhalten. So konnte ich bei einem abgeschnittenen Blattstück, das in einer dampfgesättigten Luft und unter konstanter Lichtintensität gehalten wurde, keine Beeinflussung der Spaltweite durch die von 7° bis 25°C geänderte Lufttemperatur wahrnehmen.

Eine weitere Untersuchung stellte ich mit einem Blatt an, das von oben lokal mit Wassertropfen oder mit Eismasse abgekühlt wurde. Das Resultat war aber ganz eindeutig, also weisen in diesem Falle die warmen und kalten Blatteilen keine Verschiedenheit der Spaltweite auf.

Wie schon erwähnt, ist es bei dem mit dem künstlichen Regen hervorgerufenen Stomawechsel von *Fatsia* ganz einerlei, ob die Temperatur desselben Regens mehr, sogar um 10°C, oder weniger schwankt. Ein solcher Temperaturwechsel ist nicht bei natürlichem Regen zu erwarten, weil die Temperatur des Regens durchschnittlich nicht erheblich von der Lufttemperatur abweicht, meistens nämlich etwas niedriger als diese ist (HANN-SÜRING, 1926, S. 324).

Auf Grund dieser Tatsachen ist es von vornherein klar, dass die Spaltöffnung von *Fatsia* kaum von dem Temperaturzustande des Regens beeinflusst wird.

### (4) Regen als hydrischer Faktor

Regen wirkt als Wasserfaktor unmittelbar durch Benetzung und mittelbar durch Luftfeuchtigkeitserhöhung. In der Natur kommt es sehr selten vor, dass die Blattunterseite durch Regenwasser nass wird, mögen die Blätter gleich selbst einem Regenstrom ausgesetzt werden. Die Sache verhält sich aber anders in meinen Versuchen mit künstlichem Regen, weil da die Blattunterseite häufig mit Spritzern benetzt werden kam. Um diesen Mangel zu beseitigen, habe ich einen neuen Versuch in diffusum Licht ausgeführt. Bloss die Oberseite eines frischen Blattes benetzte ich diesmal mittelst einer mit Wasser getränkten Bürste. Die Benetzbarkeit des Blattes von *Fatsia* ist mässig: Wassertropfen haften tropfenweise oder hautartig auf der Blattoberfläche an. Die dabei beobachtete Veränderung der Spaltweite ging etwa wie die bei künstlichem Regenfall vor sich, aber

sie ist zu schwach, um den Einfluss des Regens durch diesen Faktor allein zu erklären.

Die Luftfeuchtigkeit wird gewöhnlich mit Anfang des Regens gesättigt, und sie fällt plötzlich, wenn es zu regnen aufgehört hat, so dass ihre Schwankung bei Platzregen oder beim künstlichen Regen oft etwa 50% erreichen kann. Um nun die Beeinflussung der Spaltweite durch Feuchtigkeitserhöhung zu erkennen, habe ich ein Blatt von *Fatsia* aus dem trockenen Gewächshause in die Feuchtkammer gebracht. Durch diese Behandlung wurden die Stomata sowohl des frischen als auch des welken Blattes auf dieselbe Weise wie durch den künstlichen Regenfall beeinflusst; z.B. am 24. Jan. 1937 trug ich die frischen Blätter um 11,35 Uhr in die Feuchtkammer, in der die Luftfeuchtigkeit etwa 70% betrug, oder 45% höher als im Gewächshause war. Dabei trat ein Schliessen der Stomata in die Erscheinung, und nach 15 Minuten wurde die Spaltweite minimal, dann folgte eine Öffnungsbewegung, und um 12,40 Uhr erreichte die Weite ihr Maximum, dagegen schlossen sich die Stomata des Kontrollblattes schon nach dem Maximum um Mittag ziemlich schnell. Einen diesbezüglichen Stomaverschluss haben schon STÅLFELT (1929) und TAGAWA (1936) konstatiert.

## V. Der Mechanismus der Spaltöffnungsbewegung zur Regenzeit

Auf Grund seiner sorgfältigen Studien hat STÅLFELT (1929) bestätigt, dass die Stomabewegungen durch drei verschiedene, nämlich passive, photoaktive und hydroaktive Reaktionssysteme bestimmt werden, und das erste bei supraoptimalem, das zweite bei optimalem, das letzte bei suboptimalem Wasservorrat die Bewegung hauptsächlich beherrscht. Diese Auffassung kann freilich auf den Mechanismus der Stomabewegung beim Regenfall angewandt werden, und er entspricht hier besonders dem passiven Reaktionssystem.

### (1) Die Struktur des Spaltöffnungsapparates der Versuchspflanze

Der Spaltapparat von *Fatsia* hat, wie es in Fig. 3 gezeigt wird, eine allgemeine Gestalt. Die Länge des Apparates beträgt  $25\ \mu$ , seine Breite  $20\ \mu$  und die Länge der Spalte  $15\ \mu$ . Der Spaltapparat ist von einigen Nebenzellen umgeben, die in der Querschnittsansicht von anderen Epidermiszellen als grössere Zellen leicht sich unterscheiden lassen. Eine ziemlich dicke Kutikularschicht dehnt sich über die ganze Blattoberfläche bis auf die Aussenseite der



Fig. 3. Spaltöffnung von *Fatsia japonica*.



Schliesszellen aus, auch bedeckt eine dünne Kutikularschicht die der Atemhöhle anliegende Seite der Schliess- und Nebenzellen. Eine Schwammparenchymzelle pflegt an der Mitte der Innenwand der Nebenzelle fest zu haften.

## (2) Mitwirkung der Neben- und Epidermiszellen bei der Spaltöffnungsbewegung

Es steht bereits unzweifelhaft fest, dass die Stomabewegungen hauptsächlich auf die Turgorveränderungen der Schliesszellen zurückzuführen sind, aber bloss damit bleiben noch manche schwer erklärbare Probleme betreffs des durch die Luftfeuchtigkeitserhöhung verursachten Spaltschliessens übrig. Anderseits wurde die Ansicht, dass die Neben- und Epidermiszellen im Verein mit den Schliesszellen auf die Stomabewegung wirken können, früher von BENECKE (1892) und neuerdings von STÄLFELT (1929) u.a. geäussert. Im folgenden werde ich nun damit den Mechanismus der Stomabewegung zur Regenzeit hypothetisch zu erklären suchen.

In der feuchten Luft ist der Wasserverlust des Blattes so gering, dass die Neben- und Epidermiszellen für immer mit ihrem starken Turgordruck die Schliesszellen seitlich pressen, sodass die Spalten sich schwer erweitern, und das Maximum der Öffnung später als sonst erreicht wird.

Mit dem Beginn der Erhöhung der Luftfeuchtigkeit (beim Regenfalle) werden bei einem frischen Blatt die Neben- und Epidermiszellen zuerst an Wasser reicher, zugleich nimmt ihr Turgordruck zu, folglich drücken sie die Schliesszellen seitlich mit erhöhter Kraft, so dass die geöffneten Stomata sich plötzlich passiv verengern müssen. Danach wird der Turgordruck der Schliesszellen auch im Verlauf der Zeit mit Aufnahme des Wassers grösser, und eine langsame Öffnung der Spalten tritt wieder in die Erscheinung. Wenn die Luftfeuchtigkeit (mit Aufhören des Regens) fällt, sinkt der von aussen auf die Schliesszellen geübte Seitendruck infolge des Wasserverlustes der umgebenden Zellen ab, daher öffnen sich die Stomata rascher als zuvor (vgl. Fig. 1). Aber, da die Schliesszellen auch später ihr inneres Wasser verlieren und ihr Turgordruck abnimmt, so müssen die Spalten sich abermals schliessen.

Beim welken Blatt ist die Saugkraft der Schliesszellen so stark, dass sie mit Eintritt des Regens eine reichliche Menge Wasser aufnehmen, und ihr gestiegener Turgordruck die erste Öffnung der Stomata hervorzurufen vermag. Der Seitendruck der Neben- und Epidermiszellen wirkt auch in diesem Fall auf die Schliesszellen, aber diese Wirkung zeigt sich erst nach einiger Zeit, und hierdurch wird der darauf folgende Spaltverschluss herbeigeführt (vgl. Fig. 2).

Die oben erwähnten Erklärungen scheinen uns zu zwingen zu der Annahme, dass die Saugkraft der Schliesszellen stets stärker als die der Neben- und Epidermiszellen ist, und sie durch die Trockenheit langsam

bis zu einem hohen Wert steigen kann, aber die der beiden letzteren Zellen einen bestimmten, aber gegen den der Schliesszellen zurückstehenden Wert schnell erreicht, und anderseits die Wasseraufnahme der Schliesszellen am schwersten unter diesen drei Zellarten ist, also die Wassersättigung der Schliesszellen unter gutem Wasservorrat langsam, unter schlechtem hingegen plötzlich vor sich geht. Um die Zuverlässigkeit dieser Annahme zu prüfen, habe ich die Methylenblau-Färbung der Epidermisflocken ausgeführt. Ich tauchte nämlich die frischen mit dem Rasiermesser abgeschälten Epidermisflocken in eine M 5000 Methylenblaulösung. Nach einer Minute beobachtete ich die Färbung der Zellen mikroskopisch. Weiter prüfte ich durch Plasmolyse mit 2 M Glykoselösung, ob die Zellen noch lebten oder nicht. Vor 10 und nach 14 Uhr kann man innerhalb der ersten wenigen Minuten liess sich kein Unterschied unter den Dunkelheiten der Epidermis-, Neben- und Schliesszellen finden, aber gegen Mittag ist die Färbung der Schliesszellen zuerst sichtlich heller als die der Epidermiszellen. Zuletzt färben sich, wie LINSBAUER (1927) ausführlich angegeben hat, die Schliesszellen aber stets in allen Fällen am dunkelsten, und die Epidermiszellen am hellsten. Wenn man die eine Minute lang mit Methylenblau gefärbte Flocke unter destilliertem Wasser mikroskopisch untersucht, so wird es leicht erkannt, dass der Farbstoff, der in die Epidermis- und Nebenzellen zuerst hineintritt, im Verlauf der Zeit aus denselben in die Schliesszellen umzieht, und dieser Vorgang suggerierte uns, dass die Schliesszellen das Wasser nicht direkt, sondern indirekt durch Vermittlung der Epidermis- und Nebenzellen aufnehmen.

Dass der osmotische Druck der Schliesszellen höher als derjenige der Epidermiszellen ist, und dass er vormittags immer zunimmt und gegen Mittag sein Maximum erreicht, hat WIGGANS schon im Jahre 1921 klar gestellt. Anderseits hat KISSELEW (1925) berichtet, dass die Plasma-permeabilität der Schliesszellen an den geschlossenen Stomata grösser als an den geöffneten ist. Diese Tatsachen erleichtern die Erklärung für das mit dem Anfang des Regens vor sich gehende Öffnen der Spalten des welken Blattes.

### (3) Erhöhung des Wasservorrats des Blattes

Ob der Wassergehalt des Blattes mit Eintritt des Regens tatsächlich zunehme, ist eine weitere Frage für meine Erklärung betreffs des Mechanismus der Stomabewegung. Am klaren 16. Dez. 1936 vermehrte er sich infolge eines künstlichen Regenfalles um 10%. Es fragt sich mir nun, ob das Wasser entweder direkt von oben durch die Blattoberfläche, oder indirekt von unten durch die Schnittfläche des Blattstiels aufgenommen worden sei.

Die Menge des durch die Blattoberfläche vom Blattgewebe unmittelbar eingesaugten Wassers muss im allgemeinen sehr gering sein (WETZEL,

1924). Besonders bei einem mit dicker Kutikularschicht bedeckten Lichtblatt von *Fatsia* kann sie kaum in Betracht kommen. Ich habe ein Blattstückchen zwei Tage lang in M/5000 Methylenblaulösung eingetaucht, trotzdem färbte sich nur die Aussenseite der Kutikularschicht hellblau, der Inhalt der Epidermiszellen aber gar nicht. Durch die Stomata kann Wasser auch ins Blatt wegen der Unbenetzbarkeit der Membran der Schliesszellen kaum eindringen (URSPRUNG, 1925). Die schon erwähnte, schwache Beeinflussung der Spaltweite durch Benetzung der Oberfläche scheint also nicht von unmittelbarer Wassereinsaugung durch die Blattoberfläche, sondern hauptsächlich von der Hemmung der kutikularen Transpiration abzuhängen.

Die nächste Frage, ob die Wasseraufnahme, obgleich sie mit dem Anfang des Regens geringer wird, noch längere Zeit anhält, daher eine Wasserzunahme des Blattes dabei entsteht, kann ich durch die folgenden Versuche beweisen. Am 27. Jan. 1937 setzte ich ein in das Potetometer gestecktes Lichtblatt von *Fatsia* dem Regen aus, und am folgenden Tage tauchte ich ein Blatt invers unter Wasser. Die Wasserabgabe aus denselben Blättern, besonders im letzten Fall, musste dadurch sehr rasch herabgesetzt werden, die Wasseraufnahme von unten ging aber, wenngleich sie immer geringer wird, noch derart weiter, dass eine messbare Aufnahme nach etwa einer Stunde sich finden lässt. Nach dem Aufhören des Regens wurde die Wasseraufnahme langsam grösser. Am 3. Feb. 1937 (klares Wetter) führte ich eine weitere Untersuchung ohne künstlichen Regen aus: in diesem Fall bestimmte ich nicht nur die Aufnahme, sondern auch die Abgabe, und aus der Differenz der beiden Werte berechnete ich die Wasserzu- oder -abnahme. Im trocknen Gewächshause, dessen Luftfeuchtigkeit nur 28% war, herrschte eine Wasserabnahme in den Versuchsblättern, aber in der Feuchtkammer, deren Luftfeuchtigkeit etwa 65% betrug, geschah eine Wasserzunahme statt der Abnahme (Tab. 1).

TABELLE 1. Wasserhaushalt des Lichtblattes von *Fatsia* (cc/20 g Frischgewebe und 30 Min.). Lufttemperatur 28°C.

Rel. Luftfeucht. Versuchszeit		Im Gewächshause 28% 11,35–12,20			In der Feuchtkammer 65% 12,10–13,00			Im Gewächshause 28% 12,40–13,20		
		Abgabe	Aufnahme	Abnahme	Abgabe	Aufnahme	Zunahme	Abgabe	Aufnahme	Abnahme
I	31,65 g	2,02	1,66	–0,36	0,88	0,98	+0,10	1,93	1,52	–0,41
II	19,55	2,12	1,66	–0,46	0,72	0,99	+0,27	2,36	2,06	–0,30
III	18,30	1,68	1,60	–0,08	0,84	1,26	+0,42	2,73	1,66	–1,07

Die Resultate dieser Versuche werden folgendermassen kurz zusammengestellt: Regen beeinflusst den Wassergehalt des Blattes hauptsächlich

lich durch die Luftfeuchtigkeitserhöhung, die eine Veränderung des Turgordrucks in der Zelle hervorruft.

## VI. Zusammenfassung

1. Die vorliegende Untersuchung beabsichtigt, einen Beitrag über die Beeinflussung der Spaltweite durch Regenfall zu liefern. Als Versuchspflanze diente mir hauptsächlich *Fatsia japonica*, die sowohl dem natürlichen als auch dem künstlichen Regen ausgesetzt wurde.

2. Die Stomata von *Fatsia*, *Erigeron*, *Ricinus*, *Cornus*, *Polia* und *Camellia* zeigen im Freien einen gleichartigen täglichen Weitenwechsel. An feuchten Tagen tritt die maximale Öffnung der Stomata später als an trocknen zutage. Zur Regenzeit ist dieselbe kleiner als am klaren Tag.

3. Beim frischen Blatt von *Fatsia* schliessen sich die weit geöffneten Stomata mit Eintritt des Regens plötzlich, dann folgt eine langsame Öffnungsbewegung. Beim welken Blatt öffnen sich zuerst die eng geschlossenen Stomata, und nach der maximalen Öffnung fangen sie wieder an sich zu schliessen. Wenn es aufgehört hat zu regnen, tritt eine rasche Öffnungsbewegung sowohl beim frischen als auch welken Blatt auf, aber eine neue Schliessung entsteht nach einiger Zeit in beiden Blättern.

4. Das durch Regenfall verursachte Schliessen und Öffnen der Spalten beruhen hauptsächlich auf der Veränderung der Luftfeuchtigkeit. Die Veränderung der mechanischen, photischen und thermischen Aussenfaktoren kommen kaum in Betracht. Die Benetzung der Blattoberfläche ist dagegen mehr oder weniger wirkungsvoll.

5. Die eigentümlichen Stomabewegungen zur Regenzeit können hypothetisch als die vereinigte Folge der zwischen Schliess-, Neben- und Epidermiszellen vor sich gehenden gegenseitigen Wirkungen der Turgordrucke, die zufolge der Zu- oder Abnahme des Wasservorrats in den Zellen entstanden sind, erklärt werden. Die Veränderung des Wasservorrats rührt hauptsächlich von der gehemmten Transpiration, die mit der durch Regenfall vergrösserten Luftfeuchtigkeit Hand in Hand geht.



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Studies in the cytology of Pteridophyta  
XV. A critical consideration of cytological fixation and  
staining in the sporophytic cells, prothallium-cells  
and spermatozoids of *Dryopteris uniformis* MAKINO

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(Received January 11, 1938)

According to YAMAHA (1924) both the nucleus-staining and its purity are greatly affected by the fixatives used in the root-tip-cells of *Vicia Faba* and the pollen sac-cells of *Lilium speciosum*. He (1932) also concluded, in his work on the root-tip-cells of *Vicia Faba*, that the stainability of the fixed protoplasm-structure was affected by various caryotin-staining dyes and by SCHUMACHER's lipid-staining ones. CARLSON (1936) stated that in the staining with HEIDENHAIN's iron-alum haematoxylin, crystal violet or safranin-iodine, the stainability of the different cell-structures of the root-tip-cells of *Zea Mays* was conditioned directly by the fixatives used. These results have been obtained in the higher plants and it seems necessary to learn in Pteridophyta whether the same relation can be found or not and what fixative can result in good fixation and staining.

As YAMAHA (1936) stated the term "good fixation of protoplasm" does not necessarily mean that the protoplasm-structures are preserved nearest to the living state. The term "good fixation of protoplasm" for most investigators means that the protoplasm is preserved as clearly as possible for the purpose of observing its fine structures, and so-called good fixation does not mean the preservation of the true structure of protoplasm.

However, it is important to compare the various structures of the protoplasm, which have been found in the most suitable state for observation from the view-point of cytomorphology, with those in living state and to make the various protoplasm-structures clear. In the present case, the writer means by the term "good fixation of protoplasm" that the protoplasm is preserved in the most suitable state for observation from the cytomorphological view point without any resulting shrinkage or swelling of the cell, when stained with HEIDENHAIN's iron-alum haematoxylin.

The present work has been undertaken to give some sort of an answer to the questions:

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(1) A preliminary report of this work was contained in the Japanese Journal of Genetics, **13** (1937), pp. 48-50.

What fixatives can fix well and also give good staining with HEIDENHAIN's iron-alum haematoxylin for the sporophytic cells or prothallium-cells of *Dryopteris uniformis* MAKINO, and what kind of mixture or what quantity of the components can secure a good fixation.

YAMAHA (1932) stated that the nuclei of the root-tip-cells of *Vicia Faba* showed negative nucleal-reaction when they were fixed with nitric acid, trichlor-acetic acid, MERKEL's solution, BOUIN's solution or ZENKER's solution. On the other hand, the fact that the reaction-colour of FEULGEN's nucleal-reaction was affected by the density of the chromatin-substance has been stated by MILOVIDOV (1936); and the present writer (1937) has already stated that the nucleal-reaction of the sporophytic cells of some Pteridophytes was greatly affected by the percentage of chromic acid which was used as the fixative. The nuclei of the leaf-cells of some Pteridophytes show a negative nucleal-reaction when they are fixed with an aqueous solution of chromic acid of a certain percentage strength. This critical percentage is different according to the species of plants when the fixation is constant (1937).

In the present study it is also considered whether FEULGEN's nucleal-reaction of the nuclei of sporophytic leaf-cells, prothallium-cells, spore-mother-cells and spermatids is affected by the fixative employed when they are subjected to paraffin-method, and what component of the fixative affects the differences of the nucleal-reaction.

The nucleal-reaction of the spermatozoid of Pteridophyta was already studied by the writer (1935, 1936) and MILOVIDOV (1936), and they showed a positive nucleal-reaction of the spermatozoid-nucleus. In the present case the action of the fixative on the reaction-colour of the spermatozoid-nucleus was also ascertained by the smear method.

There have been hitherto no studies regarding the good fixation and staining of spermatozoid and the effect of the fixative on the staining. These studies, however, may be important in studying the detailed structure of spermatozoid; and the results of studying the spermatozooids of *Dryopteris uniformis* MAKINO will be found in this paper.

## Materials and methods

The sporophytic leaves and prothallia of *Dryopteris uniformis* MAKINO (Japanese name: Wokumawarabi) were fixed with various fixatives, sectioned in  $8\mu$  thickness by the paraffin-method and stained with HEIDENHAIN's iron-alum haematoxylin method to confirm the degree of the fixation and staining.

To test FEULGEN's nucleal-reaction the unstained preparations which were made by the paraffin-method, after being fixed with various fixatives were hydrolysed for 4 minutes at  $60^{\circ}\text{C}$  in  $n\text{HCl}$ , immersed in cold  $n\text{HCl}$

for 5 minutes, stained in fuchsin-sulphurous acid for 2 hours, washed in dist. water containing sulphurous acid for 20 minutes, dehydrated in alcohol- and xylol-series, imbedded in balsam and then examined under the microscope. The fixatives used were as follows (N.B.: the time for fixation is 24 hours with the exception of those whose fixation-times are shown in parentheses): 1) picric acid saturated in water, 2) 3% aq. sol. of potassium bichromate, 3) 2% aq. sol. of trichlor-acetic acid, 4) acetone, 5) 1% aq. sol. of urea, 6) corrosive sublimate saturated in water, 7) 3% sulphuric acid, 8) glacial acetic acid, 9) absolute alcohol, 10) 95% alcohol, 11) 1% aq. sol. of chromic acid, 12) 3% nitric acid, 13) ZENKER's solution (without acetic acid) (potassium bichromate 2-2.5 gms., sodium sulphate 1 gm., corrosive sublimate 5 gms., glacial acetic acid 5 c.c., dist. water 100 c.c.), 14) CARNOY's fluid (6:3:1) (absolute alcohol 6, glacial acetic acid 3, chloroform 1), 15) CARNOY's fluid (3:1) (absolute alcohol 3, glacial acetic acid 1), 16) chrom-acetic acid solution (strong) (chromic acid 1 gm., glacial acetic acid 3 c.c., dist. water 100 c.c.), 17) MEVES' solution (2% aq. sol. of osmic acid 4 c.c., 0.5% aq. sol. of chromic acid 15 c.c., NaCl 0.15 gm.) (fixed for 12 hours), 18) LA COUR's solution (1% aq. sol. of chromic acid 90 c.c., potassium bichromate 1 gm., sodium sulphate 0.5 gm., urea 1 gm., 5% aq. sol. of acetic acid 10 c.c.), 19) ZIRKLE's solution (chromic acid 2.5 gms., glacial acetic acid 2.5 c.c., cuprous oxide a little, dist. water 100 c.c. [pH 4.6]), 20) BOUIN's solution (formalin 25 c.c., picric acid saturated in water 75 c.c., glacial acetic acid 5 c.c.), 21) BOUIN-ALLEN's solution (BOUIN's solution 100 c.c., chromic acid 1.5 gm., urea 2 gms.), 22) REGAUD's solution (3% aq. sol. of potassium bichromate 80, formalin 20) (postchromisation with 3% potassium bichromate), 23) GILSON's solution (95% alcohol 42 c.c., glacial acetic acid 18 c.c., nitric acid 2 c.c., corrosive sublimate saturated in water 11 c.c., dist. water 60 c.c.), 24) JUNGERS' solution (1934) (picric acid saturated in water 4, formalin 1) (post-chromisation with 3% aq. sol. of potassium bichromate), 25) MEVES' solution (chondriosome-method) (2% aq. sol. of osmic acid 4 gms., 0.5% chromic acid 15 gms., NaCl 0.15 gm.), 26) CHAMPY's solution (2% aq. sol. of osmic acid 4 c.c., 3% aq. sol. of potassium bichromate 8 c.c., 1% aq. sol. of chromic acid 8 c.c.) (fixed for 24 or 48 hours), 27) formalin-alcohol-acetic acid fluid (50% alcohol 100 c.c., formalin 16.5 c.c., glacial acetic acid 2.5 c.c.), 28) sublimate-formalin (corrosive sublimate saturated in water 80 c.c., formalin 20 c.c.), 29) BENDA's solution (2% aq. sol. of osmic acid 4 c.c., 1% chromic acid 15 c.c., glacial acetic acid 2 or 3 drops) (fixed for 24 or 48 hours), 30) BENDA's solution (chondriosome-method), 31) ALTMANN's solution (5% aq. sol. of potassium bichromate 10 c.c., 2% aq. sol. of osmic acid 10 c.c.), 32) FLEMMING's solution (strong) (2% aq. sol. of osmic acid 12 c.c., 1% aq. sol. of chromic acid 45 c.c., glacial acetic acid 3 c.c.),



33) FLEMMING's solution (weak) (1% aq. sol. of chromic acid 25 c.c., 1% acetic acid 10 c.c., 1% aq. sol. of osmic acid 10 c.c., dist. water 55 c.c.), 34) FLEMMING's solution (Bonn) (1% aq. sol. of chromic acid 60, 2% aq. sol. of osmic acid 8, glacial acetic acid 4, dist. water 72), 35) chrom-acetic acid solution (strong) + dist. water (1:1), 36) BENDA-ERLICKI's solution [1 (1% chromic acid 17 c.c., 2% osmic acid 3 c.c., glacial acetic acid 2 drops), II (2% aq. sol. of copper sulphate 5% aq. sol. of potassium bichromate, mix in the same volume just before using), fix 36 hours in solution I, wash two hours, fix 24 hours in solution II], 37) formalin-CARNOY's fluid (absolute alcohol 6, chloroform 3, glacial acetic acid 1 or 0.5, formalin 1), 38) KAISER's solution (corrosive sublimate 10 gms., glacial acetic acid 3 c.c., dist. water 300 c.c.).

The leaf and prothallium were also treated with FEULGEN's nucleal-reaction directly after being fixed with CHAMPY's solution, chrom-acetic acid solution (strong), KAISER's solution or 1% aq. sol. of chromic acid.

To confirm which were the good fixatives and also to learn the effect of fixative on the staining of spermatozoid the dry preparations which were fixed by various fixatives were stained with HEIDENHAIN's iron-alum haematoxylin or gentian violet, washed in water, dried up, embedded in Canada balsam and observed under the microscope. In making a dry preparation, a hanging drop of water containing many spermatozooids was evaporated on a slide after being exposed over osmic fume or adding a drop of fixative, washed in water for 5 minutes (with the exception of those materials fixed with CARNOY's fluid or absolute alcohol), and dried again by the application of 100 W. lamp heat. The dry preparation which was fixed with 2% aq. sol. of osmic acid (fume) or with a fixative containing osmic acid was bleached in hydrogen peroxide for 5 minutes, washed in water and again dried by the application of heat.

As a control the spermatozooids were also dried on a slide by the application of gas flame or 100 W. lamp heat without adding a drop of fixative and were stained with HEIDENHAIN's iron-alum haematoxylin or gentian violet. A large number of the living spermatozooids were also observed under the microscope to make a comparison with those that had been fixed.

In order to make clear the locality of chromatin-substance and to test the effect of the fixative on the nucleal-reaction the dry preparations of spermatozooids which were fixed by various fixatives were subjected to FEULGEN's nucleal-staining. That is to say, the dry preparations were hydrolysed in *n* HCl at 60°C for 4 minutes, put in cold *n* HCl for 5 minutes, stained in fuchsin-sulphurous acid for 2 hours, put in dist water containing sulphurous acid for 20 minutes, washed in water again, dried up, embedded in Canada balsam and observed under the microscope.

The following fixatives were employed for the study of spermatozooids:

picric acid saturated in water; 3% aq. sol. of potassium bichromate; 2% aq. sol. of osmic acid (fume); 3% aq. sol. of trichlor-acetic acid; acetone, 1% aq. sol. of urea; corrosive sublimate saturated in water; formalin (commercial); 3% sulphuric acid; glacial acetic acid; absolute alcohol; 95% alcohol; 1% aq. sol. of chromic acid; 3% aq. sol. of nitric acid; ZENKER's solution (without acetic acid); CARNOY's fluid; chrom-acetic acid solution (strong); MEVES' solution (12 hours); LA COUR's solution; ZIRKLE's solution; BOUIN's solution; BOUIN-ALLEN's solution; REGAUD's solution; GILSON's solution; JUNGERS' solution (1934); MEVES' solution (chondriosome-method); CHAMPY's solution (48 hours); formalin-alcohol-acetic acid fluid; sublimate-formalin solution; CHAMPY's solution (24 hours); BENDA's solution; ALTMANN's solution; FLEMMING's solution (strong); chrom-acetic acid solution (strong) + dist. water (1:1); BENDA's solution (chondriosome-method); FLEMMING's solution (Bonn); BENDA-ERLICKI's solution; CARNOY's fluid (3:1); formalin-CARNOY's fluid, and KAISER's solution.

## Observations

### 1. SPOROPHYTIC LEAF-CELLS AND PROTHALLIUM-CELLS

#### A) HEIDENHAIN's iron-alum haematoxylin staining

In order to make clear the effects of fixatives on the leaf-cells, spore-mother-cells, prothallium-cells and spermatids, the materials fixed with various fixatives were sectioned by the paraffin-method and stained with HEIDENHAIN's iron-alum haematoxylin. The results are shown in TABLE I.

The fixatives which have given the best fixation and staining with HEIDENHAIN's iron-alum haematoxylin for the general structure of the cell, especially the nucleus are 2% aq. sol. of osmic acid, 1% aq. sol. of urea, 1% aq. sol. of chromic acid, chrom-acetic acid solution (strong), FLEMMING's solution (Bonn); MEVES' solution (12 hours); ZIRKLE's solution, GILSON's solution and chrom-acetic acid solution (strong) + dist. water (1:1).

The fixing mixtures of the above-mentioned fixatives, except GILSON's solution, contain chromic acid and the latter is an important constituent for the good fixation and staining of the general structure of the cell, especially the nucleus. These fixing mixtures also contain acetic acid with the exception of MEVES' solution, showing the good cooperative effect of acetic acid.

The proportions of chromic acid and acetic acid in 100 c.c. dist. water in these fixatives are shown in TABLE II (p. 157).

As shown in this table the good fixatives which give good fixation and staining of the general structures of the cell, especially the nucleus, contain chromic acid and acetic acid to the extent of 0.4-1 gm. and 1.4-3 c.c. respectively to 100 c.c. dist. water.

TABLE I HEIDENHAIN'S iron-alum haematoxylin staining (paraffin-method)

Fixatives	Leaf-cell	Prothallium-cell	Spore-mother-cell	Spermatid	Chromosome of leaf-cell	Leaf- and prothallium-cell				Remarks
						Reticular threads	Reticular granules	Nucleolus	Mitochondria	
Picric acid saturated in water	L	g	g		+++	+++	+++	+++	++	+++
	P		g	g	+++	+++	+++	+++	±	—
3% aq. sol. of potassium bichromate	L	b cs			+++	+++	+++	+++	+++	+++
	P		b cs			+++	+++	+++	±	+
2% aq. sol. of osmic acid	L	g	g		+++	+	+++	+++	±	+++
	P		g	g		+	+	+++	±	+
3% aq. sol. of trichloroacetic acid	L	rs	rs		+++	+++	+++	+++	±	+++
	P		g	g		+++	+++	+++	±	—
Acetone	L	s	g		+++	+++	+++	+++	+	+++
	P		g	g	++	+	++	++		++
1% aq. sol. of urea	L	g	g		+++	+++	+++	+++	±	+
	P		g			+++	+++	+++	±	+++

TABLE I (Continued)

Fixatives	Leaf- and prothallium-cell											Remarks	
	Leaf-cell	Prothallium-cell	Spore-mother-cell	Spermatid	Chromosome of leaf-cell	Nucleus			Mito-chondria	Cytoplasm	Spindle		Plastid
Corrosive sublimate saturated in water	L	rs			+++ +	+++ +	+++ +	+++ +	+	±	—	++ +	Good fixation of cytoplasm.
	P		rs	g	+++ +	+++ +	+++ +	+++ +	+	±	—	+	
Formalin (commercial)	L	s			+++ +	+++ +	+++ +	+++ +	+	±	+	++ +	
	P		s	s	+++ +	+++ +	+++ +	+++ +	+	±	—	—	
3% sulphuric acid	L	g			+++ +	+++ +	+++ +	+++ +	—	±	—	++ +	Good fixation but inadequate staining.
	P		ed	ed	+++ +	+++ +	+++ +	+++ +	—	±	—	+	
Glacial acetic acid	L	s	rs		+++ +	+++ +	+++ +	+++ +	—	±	—	—	
	P		s	s	+++ +	+++ +	+++ +	+++ +	—	±	—	—	
Absolute alcohol	L	s			+++ +	+++ +	+++ +	+++ +	—	±	—	+	
	P		s	s	+++ +	+++ +	+++ +	+++ +	—	±	—	—	
95 % alcohol	L	s			+++ +	+++ +	+++ +	+++ +	—	±	—	++ +	
	P		rg	rg	+++ +	+++ +	+++ +	+++ +	—	±	—	+	



TABLE I (Continued)

Fixatives	Leaf-cell		Prothallium-cell	Spore-mother-cell	Spermatid	Chromosome of leaf-cell	Nucleus				Leaf- and prothallium-cell			Remarks
	L	cs					Reticular threads	Reticular granules	Nucleolus	Mitochondria	Cytoplasm	Spindle	Plastid	
1% aq. sol. of chromic acid	L	cs		g		++	++	++	++	++	++	-	++	Good fixation and staining.
	P		g		g		++	++	++	-	±		+	
3% nitric acid	L	rs				+++	+++	+++	+++	+	±	-	++	Shrinks somewhat, but remarkably good fixation.
	P		s ed		ed		++	++	++	-	±		+	
ZENKER's solution (without acetic acid)	L	rs		g		+++	+++	+++	+++	+	±	-	++	Good for the study of spermatogenesis.
	P		rs		g	+++	+++	+++	+++	+	±		+	
CARNOY's fluid (6:3:1)	L	b		g		+++	++	+++	+++	+	±	-	+	Good for the study of sporogenesis.
	P		s		s	+++	+++	+++	+++	+	±		-	
Chrom-acetic acid solution (strong)	L	g		g		+++	++	+++	+++	+	±	+	++	Good fixation and staining.
	P		g		g	+++	++	+++	+++	+	±	+	+	
FLEMING's solution (Bonn)	L	g		g		+++	++	+++	+++	+	±	-	++	Good fixation and staining.
	P		g		g	+++	++	+++	+++	+	±	-	+	

TABLE I (Continued)

Fixatives	Leaf- and prothallium-cell													Remarks
	Leaf-cell	Prothallium-cell	Spore-mother-cell	Spermatid	Chromosome of leaf-cell	Nucleus			Mitochondria	Cytoplasm	Spindle	Plastid		
						Reticular threads	Reticular granules	Nucleolus						
MEVES' solution (12 hours)	L	g			+++	—	—	+++	—	±	—	++	Good fixation of plastids.	
	P		g	g		—	—	+++	—	±		++		
LA COUR's solution	L	cs			+++	+		+++	—	±	—	+++		
	P		s	g		+		+++	—	±		+		
ZIRKLE's solution	L	cs			+++	+++		+++	+	±	+	++	Good fixation and staining. Plastids are stained in their periphery.	
	P		g	g		++		+++	++	±		+		
BOUIN's solution	L	cs			+++	+++		+++	+	±	+	++		
	P		cs	g		+++		+++	+	±		++		
BOUIN-ALLEN's solution	L	ed s			+++	+++		+++	—	±	—	++	Nuclei are easily stained homogeneously. Cytoplasm granulates.	
	P		b	b	+++	+++		+++	+	±	—	—		
REGAUD's solution	L	g			+++	+++		+++	+	±	—	++	Good fixation and staining of cytoplasm.	
	P		g	g	+++	+++		+++	+	±	—	+		

TABLE I (Continued)

Fixatives	Leaf- and prothallium-cell												Remarks
	Leaf-cell	Prothallium-cell	Spore-mother-cell	Spermatid	Chromosome of leaf-cell	Nucleus			Mito-chondria	Cytoplasm	Spindle	Plastid	
						Reticular threads	Reticular granules	Nucleolus					
GILSON'S solution	L	g			++	++	+	++	+	±	+	++	Good fixation and staining.
	P		rs	rs	++	++	+	++	-	±	+	+	Good fixation of nucleus.
JUNGERS' solution	L	g			++	-	-	++	+	±	-	+	Rather good fixation of cytoplasm.
	P		g	g		-	-	++	+	±		+	
MEVES' solution (chondriosome-method)	L	g				+++	+++	+++	++	+		++	Shrinks. Good fixation and staining of mitochondria, cytoplasm and plastids.
	P		rs	rs		+++	+++	+++	+	+		+	
CHAMPY'S solution (48 hours)	L	g				+++	+++	+++	++	±		++	Good fixation of cytoplasm, plastids and mitochondria.
	P		rs	rs		+++	+++	+++	+	±		+	
Formalin alcohol-acetic acid fluid	L	s			+++	+	+	+++	-	±	-	++	
	P		s	s	+++	+	+	+++	-	±	-	-	
Sublimate-formalin solution	L	cs				+++	+++	+++	+	±		++	Nuclei are stained homogeneously.
	P		cs	cs		+++	+++	+++	+	±		+	

TABLE I (Continued)

Fixatives	Leaf- and prothallium-cell												Remarks	
	Leaf-cell	Prothallium-cell	Spore-mother-cell	Spermatid	Chromosome of leaf-cell	Nucleus				Mito-chondria	Cytoplasm	Spindle		Plastid
CHAMPY's solution (24 hours)	L	cs	g		+++	—	—	+++	+++	++	±	—	++	Good fixation and staining of mitochondria and plastids.
	P		cs	cs		—	—	+++	+++	++	±		+	
BENDA's solution (24 hours)	L	cs	g		+++	++	+++	+++	+++	++	±	—	+	Good fixation and staining of mitochondria and plastids.
	P		g	g		—	—	+++	+++	++	±		+	
ALTMANN's solution	L	g	g		+++	+++	+++	+++	+++	+++	±	—	+++	Good fixation and staining of plastids. Nuclei are stained homogeneously.
	P		cs	cs		+++	+++	+++	+++	+++	±		+++	
FLEMMING's solution (strong)	L	rs	g		+++	++	+++	+++	+++	—	±	—	++	
	P		rs	rs	+++	+++	+++	+++	+++	—	±		+	
Chrom-acetic acid solution (strong) + dist. water (1:1)	L	g	g		+++	+++	+++	+++	+++	+	±	—	++	Good fixation and staining of spore-mother-cells.
	P		g	g		+++	+++	+++	+++	+	±		+	Good for the study of spermatogenesis.
BENDA's solution (chondriosome-method)	L	g	g			+++ or —	+++ or —	+++	+++	++	±		++	Good fixation of cyt. plasm.
	P		g	g		++ or —	++ or —	++ or —	++ or —	+	±		++	



TABLE I (Continued)

Fixatives	Leaf-cell		Prothallium-cell	Spore-mother-cell	Spermatid	Chromosome of leaf-cell	Leaf- and prothallium-cell						Remarks		
	L	P					Reticular threads	Reticular granules	Nucleolus	Mitochondria	Cytoplasm	Spindle	Plastid		
FLEMING'S solution (weak)				g			+	+	++	+	±		++	+	Good fixation of cytoplasm.
					g		+	+	++		±		++	+	Good for the study of spermatogenesis.
BENDA-ERLICKI'S solution	L		g			+++	+	+	++	+++	±	—	++	+	Good fixation and staining of mitochondria, cytoplasm and plastids.
		P		g			+	+	++	+	±		+		
CARNOY'S fluid (3:1)	L					++	++	++	++	+	±	—	++		Good for the study of sporogenesis.
		P			rs		+	+	++	+	±		+		
Formalin-CARNOY'S fluid	L					+++	++	+++	+++	+	±	—	+		Good fixation of spore-mother-cells.
		P			rs	+++	++	+++	+++	+	±	—	+		

b = Bad fixation.

cs = Cytoplasm shrinks.

ed = Easily destroyed.

g = Good fixation of the general structure of cell.

rg = Rather good fixation.

rs = Cytoplasm shrinks somewhat.

rs = Cytoplasm swells.

s = Cell shrinks.

++++ = Very deeply stained.

+++ = Deeply stained.

++ = Lightly stained.

+ = Very lightly stained.

± = Very lightly stained or unstained (ambiguous case).

— = Unstained.

L = Sporophytic leaf-cell

P = Prothallium-cell

TABLE II

Fixatives	Quantity of chromic acid to 100 c.c. dist. water in the fixative	Quantity of acetic acid to 100 c.c. dist. water in the fixative
Chrom-acetic acid solution (strong)	1 gm.	3 c.c.
FLEMMING's solution	0.4 gm.	2.9 c.c.
MEVES' solution	0.4 gm.	
ZIRKLE's solution	2.5 gms.	2.5 c.c.
GILSON's solution		2.8 c.c.
Chrom-acetic acid solution + dist. water (1:1)	0.5 gm.	1.4 c.c.

In fact the fixative which is composed of chromic acid 0.75 gm., glacial acetic acid 2.5 c.c. and dist. water 100 c.c. results in a good fixation and staining of the general structure of the cell, especially the nuclei, of sporophytic leaf-cells and prothallium-cells in *Dryopteris uniformis*, as shown in TABLE III (1st column).

Therefore a good fixation and staining of the sporophytic leaf cells and prothallium-cells of *Dryopteris uniformis* can be obtained by the use of 2% aq. sol. of osmic acid, 1% aq. sol. of urea, 1% aq. sol. of chromic acid or the cooperative action of chromic acid and acetic acid.

3% sulphuric acid gives a remarkably good fixation, but causes over-staining. When fixed with 3% nitric acid the cells, especially the prothallium-cells, shrink somewhat, but a rather good fixation of leaf-cells will result.

For the fixation and staining with HEIDENHAIN's iron-alum haematoxylin of cytoplasm 3% aq. sol. of trichlor-acetic acid, corrosive sublimate saturated in water, REGAUD's solution, JUNGERS' solution, MEVES' solution (chondriosome-method), CHAMPY's solution (48 hours), FLEMMING's solution (weak), BENDA's solution (chondriosome-method) and BENDA-ERLICKI's solution give good results.

The fixing mixtures of the above-mentioned fixatives except JUNGERS' solution contain chromic acid or potassium bichromate or both. Therefore the effects of chromic acid or potassium bichromate are thought to be important for the good fixation and staining of cytoplasm.

In cytological technique the material which is fixed with JUNGERS' solution must be postchromated with 3% aq. sol. of potassium bichromate; this fact shows the good effect of potassium bichromate.

TABLE III

Fixatives	General structure of leaf-cell	General structure of prothallium-cell	Leaf- and prothallium-cell						Remarks	
			Nucleus			Mito- chondria	Cytoplasm	Spindle		Plastid
			Reticu- lar threads	Reticu- lar gran- ules	Nu- cleolus					
1 { Chromic acid 0.75 gm. Glacial acetic acid 2.5 c.c. Dist. water 100 c.c.	L	g	++	++	+++	—	—		+++	Nucleus stains, being granulated. Starch grains stain faintly.
	P		++	++	+++	—	—		+	
2 { NaCl 0.7 gm. Dist. water 100 c.c.	L	g	±	±	±	+	—		+	Nuclei stain faintly or are unstained. Starch grains are not stained. Cytoplasm is destroyed.
	P		±	±	±	+	—		++	
3 { Chromic acid 0.5 gm. Potassium bichromate 1.5 gm. Dist. water 100 c.c.	L	cs	+++	+++	+++	—	—		+++	Starch grains stain faintly. Cytoplasm shrinks.
	P		+++	+++	+++	—	—		++	
4 { Potassium bichromate 1.5 gm. Dist. water 100 c.c.	L	cs	+++	+++	+++	+	—		+++	Nuclei stain homo- geneously and yet deeply. Starch grains are not stained. Plastids are somewhat destroyed.
	P	b cs	+++	+++	+++	—	—		+	
5 { Chromic acid 0.5 gm. Dist. water 100 c.c.	L	g	++	+++	+++	++	±	—	++	Starch grains stain faintly.
	P		++	+++	+++	—	±		+	
6 { Osmic acid 0.7 gm. Potassium bichromate 1.7 gm. Dist. water 100 c.c.	L	g	—	—	—	+	—		+++	
	P		—	—	—	+	—		+++	

TABLE III (Continued)

Fixatives	General structure of leaf-cell	General structure of prothallium-cell	Leaf- and prothallium-cell						Remarks		
			Nucleus				Mitochondria	Cytoplasm		Spindle	Plastid
			Reticular threads	Reticular granules	Nucleolus						
7 { Osmic acid 0.7 gm. Chromic acid 0.5 gm. Dist. water 100 c.c.	L	g	+	+	+++	++	-		+++	Nuclei stain homogeneously. Starch grains are not stained.	
	P		+	+	+++	++	-		++		
8 { Osmic acid 0.7 gm. Chromic acid 0.5 gm. Potassium bichromate 1.7 gm. Dist. water 100 c.c.	L	g	+++	+++	+++	+++	-		+++	Nuclei stain, being granulated. Starch grains stain faintly.	
	P	g	+++	+++	+++	++	-		++		
9 { Osmic acid 0.3 gm. Chromic acid 0.5 gm.* Dist. water 100 c.c.	L	g	+	+	+++	+++	-		++	Nuclei stain homogeneously. Starch grains stain faintly.	
	P	g	+	+	+++	+++	-		++		
10 { Osmic acid 0.3 gm. Chromic acid 0.5 gm. Potassium bichromate 1.1 gm. Dist. water 100 c.c.	L	g	++	++	+++	+++	-		++	Nuclei stain deeply and homogeneously. Starch grains stain faintly.	
	P	g	++	++	+++	++	-		+++		
11 { Glacial acetic acid 10 c.c. Dist. water 100 c.c.	L	rg	++++	++++	++++	-	-	++	+	Nuclei show reticular structure, being somewhat destroyed. Starch grains are not stained.	
	P	b	++	++	+++	-	-		±		

± = Very lightly stained or unstained (ambiguous case).

- = Unstained

++++ = Very deeply stained.

+++ = Deeply stained.

++ = Lightly stained.

+ = Very lightly stained.

b = Bad fixation.

cs = Cytoplasm shrinks.

g = Good fixation.

rg = Rather good fixation.



The proportions of chromic acid and potassium bichromate in 100 c.c. dist. water in these fixatives are shown in TABLE IV.

TABLE IV

Fixatives	Quantity of chromic acid to 100 c.c. dist. water in the fixative	Quantity of potassium bichromate to 100 c.c. dist. water in the fixative
REGAUD's solution		2.7 gms.
MEVES' solution	0.4 gm.	
CHAMPY's solution (fixed for 48 hours)	0.4 gm.	0.6 gm.
BENDA's solution (chondriosome-method)	0.8 gm.	
FLEMMING's solution (weak)	0.2 gm.	
BENDA-ERLICKI's solution	0.4 gm.	1.3 gm.

In these fixatives chromic acid and potassium bichromate are contained to 100 c.c. of dist. water at the rate of 0.2–0.8 gm. and 0.6–2.7 gms. respectively.

Therefore the following fixatives are prepared to get good fixation and staining of cytoplasm: chromic acid 0.5 gm., potassium bichromate 1.5 gm., dist. water 100 c.c.; potassium bichromate 1.5 gm., dist. water 100 c.c.; chromic acid 0.5 gm., dist. water 100 c.c. However, these fixatives lead to the shrinkage of cytoplasm or the general structure of the cell and are not to be regarded as good fixatives of the cytoplasm with the exception of the last-mentioned fixative which contains chromic acid only (TABLE III, 3rd–5th columns).

Judging from these facts it is supposed that a good fixation and staining of cytoplasm with HEIDENHAIN's iron-alum haematoxylin must result from 3% aq. sol. of trichlor-acetic acid, corrosive sublimate saturated in water, 0.5% aq. sol. of chromic acid or the cooperative action of chromic acid, potassium bichromate and the other components.

For the fixation and staining of plastids good results are obtained by using MEVES' solution (12 hours), MEVES' solution (chondriosome-method), CHAMPY's solution (48 hours), CHAMPY's solution (24 hours), BENDA's solution, ALTMANN's solution or BENDA-ERLICKI's solution.

All these solutions contain osmic acid and chromic acid, osmic acid and potassium bichromate, or osmic acid, chromic acid and potassium bichromate. The proportions of these constituents in 100 c.c. dist. water in the above-mentioned fixatives are shown in TABLE V.

TABLE V

Fixatives	Quantity of osmic acid to 100 c.c. dist. water in the fixative	Quantity of chromic acid to 100 c.c. dist. water in the fixative	Quantity of potassium bichromate to 100 c.c. dist. water in the fixative
MEVES' solution (chondriosome-method)	0.2 gm.	0.4 gm.	
CHAMPY'S solution (24 or 48 hours)	0.2 gm.	0.4 gm.	1.2 c.c.
BENDA'S solution	0.4 gm.	0.6 gm.	
ALTMANN'S solution	1 gm.		2.5 c.c.
BENDA-ERLICKI'S solution	0.2 gm.	0.4 gm.	1.3 c.c.

In these fixatives the proportions of chromic acid, potassium bichromate and osmic acid into 100 c.c. dist. water are 0.4–0.6 gm., 1.2–2.5 gms. and 0.2–1 gm. respectively.

So the following fixative which is composed of osmic acid and chromic acid, or osmic acid and potassium bichromate, or osmic acid, potassium bichromate and chromic acid, in the above-mentioned proportions should give a good fixation and staining of plastids: osmic acid 0.7 gm., chromic acid 0.5 gm., potassium bichromate 1.7 gm., dist. water 100 c.c.; osmic acid 0.7 gm., chromic acid 0.5 gm., dist. water 100 c.c.; osmic acid 0.7 gm., potassium bichromate 1.7 gm., dist. water 100 c.c. And in fact a good fixation and staining of plastids are achieved by using these fixatives as shown in TABLE III, 6th–8th columns.

Aq. sol. of picric acid, formalin, glacial acetic acid and absolute alcohol are not suitable for the fixation of plastids. A mixture of any of these reagents, for example, BOUIN-ALLEN's solution, also causes the bad fixation of plastids.

As shown in TABLE I the staining with HEIDENHAIN's iron-alum haematoxylin does not give always the same result according to the difference of the fixatives used. Picric acid saturated in water, 3% aq. sol. of potassium bichromate, 3% aq. sol. of trichlor-acetic acid, 1% aq. sol. of urea, corrosive sublimate saturated in water, formalin (commercial), 3% sulphuric acid, glacial acetic acid, absolute alcohol and 95% alcohol increase the stainability of protoplasm-structure, and those fixatives which contain the above-mentioned stain-increasing dyes, i.e. ZENKER's solution (without acetic acid), BOUIN's solution, BOUIN-ALLEN's solution, REGAUD's solution, CHAMPY's solution (48 hours), ALTMANN's solution, formalin-CARNOY's fluid also bring about a deep staining (c.f. YAMAHA 1932).

The nucleus is generally stained with HEIDENHAIN's iron-alum haematoxylin, when fixed with various fixatives, while in the case of fixa-

tion with MEVES' solution (12 hours), JUNGERS' solution, CHAMPY's solution (24 hours), BENDA's solution (24 hours) or BENDA's solution (chondriosome-method) the nucleus remains unstained except for its nucleolus.

When the nuclei are fixed with one of the components of JUNGERS' solution, CHAMPY's solution or BENDA's solution they are stained with HEIDENHAIN's iron-alum haematoxylin. So the unstaining of the nuclei fixed must be due to the joint effects of the components of the fixatives. In the case of MEVES' solution, however, NaCl plays an important rôle in the unstaining of the nucleus; for in most of the cases, the nuclei remain unstained if they are fixed with 0.7% aqueous solution of NaCl, which is the same proportion as in MEVES' solution.

Good fixation and staining with HEIDENHAIN's iron-alum haematoxylin of mitochondria results when the material is fixed with MEVES' solution (chondriosome-method), CHAMPY's solution (fixed for 24 or 48 hours), BENDA's solution (24 hours) or BENDA-ERLICKI's solution. These fixatives contain osmic acid and chromic acid or osmic acid, chromic acid and potassium bichromate. The proportions of osmic acid, chromic acid and potassium bichromate to 100 c.c. dist. water in the fixatives are shown in the following table (TABLE VI).

TABLE VI

Fixatives	Quantity of osmic acid to 100 c.c. dist. water in the fixative	Quantity of chromic acid to 100 c.c. dist. water in the fixative	Quantity of potassium bichromate to 100 c.c. dist. water in the fixative
MEVES' solution (chondriosome-method)	0.2 gm.	0.4 gm.	
CHAMPY's solution (48 hours)	0.2 gm.	0.4 gm.	1.2 gm.
BENDA's solution (48 hours)	0.4 gm.	0.6 gm.	
BENDA-ERLICKI'S solution	0.2 gm.	0.4 gm.	1.3 gm.

Osmic acid, chromic acid and potassium bichromate are contained to 100 c.c. dist. water in the fixatives in the proportion of 0.2–0.4 gm., 0.4–0.6 gm. and 1.2–1.3 gm. respectively.

Thus two solutions, one containing 0.3 gm. of osmic acid, 0.5 gm. of chromic acid and 1.1 gm. of potassium bichromate to 100 dist. water, and the other, 0.3 gm. of osmic acid and 0.5 gm. of chromic acid in 100 c.c. dist. water, were prepared and these fixatives have shown good fixation and staining of mitochondria (TABLE III, 9th, 10th columns).

An aqueous solution of osmic acid alone is not adequate for the fixation of mitochondria. A large quantity of acetic acid, as in the case of

LA COUR's solution, destroys the mitochondria, but it results in good fixation when used in small quantity mixed with the other constituents, as seen in the case of BENDA's solution (24 hours) or BENDA-ERLICKI's solution.

When the material is fixed with MEVES' solution according to chondriosome-method mitochondria are stained with HEIDENHAIN's iron-alum haematoxylin, while they remain unstained when fixed with MEVES' solution for 12 hours according to the usual method.

The nucleolus is always stained and even deeply whatever fixative is used. The cytoplasm is stained when fixed with acetone or MEVES' solution (chondriosome-method), but in the case of other fixatives it always remains unstained or only very faintly stained.

The spindle is stained with HEIDENHAIN's iron-alum haematoxylin when fixed with picric acid saturated in water, formalin, chrom-acetic acid solution (strong), ZIRKLE's solution, BOUIN's solution or GILSON's solution. The latter four fixatives all contain a large quantity of glacial acetic acid, namely 3 c.c., 2.5 c.c., 5.8 c.c., and 24 c.c. to 100 c.c. dist. water respectively, showing the effect of glacial acetic acid. As a matter of fact 10% acetic acid effects the staining of the spindle with HEIDENHAIN's iron-alum haematoxylin (TABLE III, 11th column). Therefore the staining of the spindle must be induced by picric acid, formalin or glacial acetic acid.

For the study of sporogenesis chrom-acetic acid solution (strong), chrom-acetic acid solution (strong) + dist. water (1:1), CARNOY's fluid (3:1), and formalin-CARNOY's fluid have been proved to be good fixatives, and for spermatogenesis ZENKER's solution (without acetic acid), chrom-acetic acid solution, chrom-acetic acid solution + dist. water (1:1), and FLEMMING's solution (weak) are good.

### **B) FEULGEN's nucleal-staining**

The nuclei of sporophytic leaf-cell, prothallium-cell, spore-mother-cell and spermatid show a positive nucleal-reaction when they are fixed with various fixatives and treated according to the paraffin-method. The nuclei of sporophytic leaf-cells, however, show a negative nucleal-reaction when fixed with chrom-acetic acid solution or CHAMPY's solution (48 hours), while those of the spore-mother-cells show a negative nucleal-reaction when fixed with CHAMPY's solution (48 hours), as did the prothallium-cells when fixed with 1% aqueous solution of chromic acid, chrom-acetic acid solution (strong) or CHAMPY's solution (24 or 48 hours).

As stated in the previous paper (1937) the nuclei of leaf-cell in some ferns show a negative nucleal-reaction either when they are fixed with aq. sol. of chromic acid of a certain percentage strength or when the fixation-time with a fixative containing chromic acid is long. In the case of



*Dryopteris uniformis* a negative nucleal-reaction of the nuclei is shown when the leaf-cells are fixed for 10 minutes with 2% aq. sol. of chromic acid or of a higher percentage and directly subjected to the reaction, as when the leaf-cells are fixed for 24 hours with 0.01–50% aq. sol. of chromic acid and directly subjected to the reaction. A negative nucleal-reaction is also shown when the leaf-cells are fixed for 10 minutes with 5% aq. sol. of chromic acid or of a higher percentage and tested to the reaction according to the paraffin-method.

In the present case it seems that CHAMPY's solution and the chrom-acetic acid solution, which have given a negative nucleal-reaction of the nucleus, contain chromic acid and have brought about a negative reaction owing to such a long fixation-time as 24–48 hours. As a matter of fact, when the leaf-cells are fixed for a short time with 1% aq. sol. of chromic acid, chrom-acetic acid solution (strong) or CHAMPY's solution, and subjected directly to FEULGEN's nucleal-reaction a positive reaction is observed.

The nucleolus shows a negative nucleal reaction, whatever fixative is used. In order to clear up the question whether FEULGEN's nucleal-reaction is or is not effected by the fixatives used, the leaf and prothallium of *Dryopteris uniformis* which have been sectioned according to the paraffin-method after being fixed with one of various fixatives have been tested for FEULGEN's nucleal-reaction. The results are shown in TABLE VII.

As shown in the TABLE VII the leaf-cells, spore-mother-cells, prothallium-cells and spermatids show a positive nucleal-reaction in their nuclei. However, as stated above, the nuclei of the leaf-cells show a negative nucleal-reaction when fixed with chrom-acetic acid solution (strong) or CHAMPY's solution (48 hours) and a weakly positive reaction when fixed with 1% aq. sol. of chromic acid or CHAMPY's solution (24 hours); while the nuclei of spore-mother-cells give a negative reaction when fixed with CHAMPY's solution (48 hours) and a very faintly positive reaction when fixed with 1% aq. sol. of chromic acid, chrom-acetic acid solution (strong), ZIRKLE's solution or CHAMPY's solution (24 hours). The nuclei of prothallium-cells are negative against this reaction when fixed with 1% aq. sol. of chromic acid, chrom-acetic acid solution (strong) or CHAMPY's solution (24 or 48 hours).

When the chromatin-substances are thickly accumulated in the nucleus the reaction-colour of the nucleus is deep, but faint, when they are roughly orientated. Therefore the nuclei of spore-mother-cells and spermatids show a deeper reaction-colour than those of leaf-cells and prothallium-cells. Chromosomes and spermatid-nuclei are positive even when the nuclei of the other cells are negative or only very weakly positive to the reaction, because in them the chromatin-substances are thickly accumulated.

TABLE VII FEULGEN'S nucleal-staining (paraffin-method)

Fixative	Sporophytic leaf			Prothallium			Remarks
	Nucleus of leaf-cell	Nucleus of spore-mother-cell	Chromo-some of leaf	Nucleus of Pro-thallium-cell	Nucleus of sper-matid	Nucleus of sper-matoid	
Picric acid saturated in water	+	+	+	+	+	+	Nucleus shows a tinge of red.
	tmr						
3% aq. sol. of potassium bichromate	+++	++++	+++++	+++	+++	+++	Good fixation and staining.
	tmr, nh						
2% aq. sol. of osmic acid	+++	+++	+++	+++	+++	+++	
	tmr, emr			emr			
3% aq. sol. of trichlor-acetic acid	+++	+++	+++++	++	+++	+++	Rather good fixation and staining.
	tmr						
Acetone	+++	+++	+++++	++	+++	+++	
	tmr, nh						
1% aq. sol. of urea	++++	++++	+++++	++++	++++	++++	Good fixation and staining.
	tmr						
Corrosive sublimate saturated in water						++++	Good fixation and staining.
	tmr						
Formalin (commercial)	+++	+++	+++	++	+++	+++	
	tmr						
3% sulphuric acid	+++	+++	+++	++	+++	++	Rather good fixation and staining.
	tmr						
Glacial acetic acid	++	++	+++	+	++	+++	
	tmr						
Absolute alcohol	++	++	+++	++	++	++	
	tmr						

TABLE VII (Continued)

Fixative	Sporophytic leaf			Prothallium			Remarks
	Nucleus of leaf-cell	Nucleus of spore-mother-cell	Chromo-some of some of leaf	Nucleus of Pro-thallium-cell	Nucleus of sper-matid	Nucleus of sper-matoid	
95% alcohol	+++	+++	+++	++	+++	+++	
	tmr						
1% aq. sol. of chromid acid	±	±	±	—	+	+	
	tmr, cmr, pr			pdr, cmr			
3% nitric acid	+++	+++	++++	+++	+++	++++	
	tmr						
ZENKER's solution (without acetic acid)	++++	++++	++++	++	+++	+++	
	tmr, nh (often)						
CARNOY's fluid (6:3:1)	+++	+++	+++	+	+++	+++	Rather good fixation and staining.
	tmr						
Chrom-acetic acid solution (strong)	—	±	±	—	+	++	
	tmr, cmr, pr, sgr			cmr, pdr, sgr			
FLEMMING's solution (Bonn)	+++	+++	+++	++	+++	+++	
	tmr, cmr			cmr, pr			
MEVES' solution (12 hours)	+	+	+	+	+++	+++	Nucleus shows a tinge of red.
	tmr, cmr, pr			cmr			
LA COUR's solution	+++	+++	+++	+++	+++	+++	Nucleus shows a tinge of red.
				pr			
ZIRKLE's solution	+	±	+	+	+	+	
	tmr, sgr, cmr			sgr, pr, cmr			
BOVIN's solution	++	++	+++	+	++	++	
	tmr						

TABLE VII (Continued)

Fixative	Sporophytic leaf			Prothallium			Remarks
	Nucleus of leaf-cell	Nucleus of spore-mother-cell	Chromosome of leaf	Nucleus of Prothallium-cell	Nucleus of spermatid	Nucleus of spermatozoid	
BOUIN-ALLEN's solution	+++	+++	+++	++	++	++	
	tmr						
REGAUD's solution	+++	++++	++++	+	+	+	
	tmr, cmr, nh			cmr			
GILSON's solution	++	++	+++	+	++	++	Rather good fixation and staining.
	tmr						
JUNGERS' solution	++	+++	+++	+	++	++	
	tmr						
MEVES' solution (chondriosome-method)	++			++	++	++	Nucleus of sporophytic cell shows a tinge of red.
	tmr, cmr			cmr			
CHAMPY's solution (48 hours)	-	-	±	-	++	++	Nucleus of sporophytic cell shows a tinge of red.
	tmr, pr, cmr,			cmr, pr			
Formalin-alcohol-acetic acid fluid	++++	++++	++++	+++	+++	+++	
	tmr, nh			nh			
Sublimate-formalin solution	++	+++	+++	++	+++	+++	
	tmr						
CHAMPY's solution (24 hours)	±	±	±	-	+	+	
	tmr, cmr, pr			pr, cmr			
BENDA's solution (24 hours)	++	++	+++	++	+++	+++	Nucleus shows a tinge of red.
	tmr, cmr, pr			cmr, pr, sgr			
ALTMANN's solution	+++	+++	+++	++	+++	+++	Nucleus shows a tinge of red.
	tmr, cmr			pr, cmr			

TABLE VII (Continued)

Fixative	Sporophytic leaf			Prothallium			Remarks
	Nucleus of leaf-cell	Nucleus of spore-mother-cell	Chromo-some of leaf	Nucleus of Pro-thallium-cell	Nucleus of sper-matid	Nucleus of sper-matozoid	
FLEMMING's solution (strong)	+++	+++	+++	+++	+++	+++	Nucleus shows a tinge of red.
	tmr, pr			cmr			
Chrom-acetic acid solution+ dist. water (1:1)	+++	+++	+++	++	+++	+++	
	tmr			pr, cmr			
BENDA's solution (chondriosome-method)	+	+	+	++	++	++	Nucleus shows a tinge of red.
	tmr, cmr, pr, sgr			cmr, pr, sgr			
FLEMMING's solution (weak)	++	++	+++	++	++	++	
	tmr						
BENDA-ERLICKI's solution	++	++	+++	++	++	++	
	tmr, cmr			cmr, pr, sgr			
CARNOY's fluid (3:1)	++	++	++	++	+++	+++	
	tmr						
Formalin-CARNOY's fluid	+++	+++	++++	++	++	+++	Rather good fixation and staining.
	tmr						
ZENKER's solution	+	+	++	+	+	+	
	tmr						

cmr = Cell-membrane shows reaction-colour.

nh = Nucleus is stained homogeneously.

pdr = Plastid shows deep reaction-colour together with its starch grains.

pr = Plastid shows lightly reaction-colour together with its starch grains.

sgr = Starch grains are stained deeply red-dish violet.

tmr = The tracheid-membrane shows reaction-colour.

++++ = Very deep reaction-colour.

+++ = Deep reaction-colour.

++ = Light reaction-colour.

+ = Very light reaction-colour.

± = Very light reaction-colour or negative reaction (ambiguous case).

- = Negative reaction.



The reaction-colour of the nucleus is beautifully violet in general, but shows a somewhat reddish tone when fixed with picric acid saturated in water, MEVES' solution (12 hours), MEVES' solution (chondriosome-method), LA COUR's solution, BENDA's solution (24 hours), ALTMANN's solution, FLEMMING's solution (strong), CHAMPY's solution (48 hours) or BENDA's solution (chondriosome-method).

The material sectioned by the paraffin-method does not suffer any conspicuous morphological changes by the process of hydrolysis. Especially when it is fixed with 3% aq. sol. of potassium bichromate, 1% aq. sol. of urea or corrosive sublimate saturated in water the material will not suffer any change and the nuclei will show a very good reaction-colour. The morphological changes of structure are also slight when the material is fixed with 3% aq. sol. of trichlor-acetic acid, 3% sulphurous acid, CARNOY's fluid (6:3:1), GILSON's solution or formalin-CARNOY's fluid.

The membrane of the tracheid always shows a reaction-colour by FEULGEN's nucleal-staining. The membranes of the leaf-cells and prothallium-cells show faint reaction-colour when fixed with one of the following solutions, viz., 2% aq. sol. of osmic acid; 1% aq. sol. of chromic acid; chrom-acetic acid solution (strong); FLEMMING's solution (Bonn); MEVES' solution (12 hours); LA COUR's solution; ZIRKLE's solution; REGAUD's solution; MEVES' solution (chondriosome-method); CHAMPY's solution (24 hours or 48 hours); BENDA's solution (24 hours); ALTMANN's solution; BENDA's solution (chondriosome-method) or BENDA-ERLICKI's solution.

The fixing mixtures of the above-mentioned fixatives contain chromic acid or osmic acid or both except in the case of REGAUD's solution. The reaction-colour of the membrane when fixed with these fixatives may be partly due to the effect of chromic or osmic acid.

The plastids in the leaf-cell show a reaction-colour, together with the starch grains which are contained within the plastids, when fixed with 1% aq. sol. of chromic acid, chrom-acetic acid solution (strong), MEVES' solution (12 hours), CHAMPY's solution (24 or 48 hours), FLEMMING's solution (strong) BENDA's solution (24 hours) or BENDA's solution (chondriosome-method). The starch grains of the leaf-cell stain deeply red in FEULGEN's nucleal-reaction when fixed with chrom-acetic acid solution (strong), ZIRKLE's solution or BENDA's solution (chondriosome-method). The plastids in the prothallium-cell show a reaction-colour together with the starch grains when fixed with 1% aq. sol. of chromic acid, chrom-acetic acid solution (strong), FLEMMING's solution (Bonn), LA COUR's solution, ZIRKLE's solution, CHAMPY's solution (24 or 48 hours), BENDA's solution (24 hours), ALTMANN's solution, chrom-acetic acid solution (strong)+ dist. water (1:1), BENDA's solution (chondriosome-method) or BENDA-ERLICKI's solution. The starch grains of the pro-

thallium-cells stain deeply red when fixed with chrom-acetic acid solution (strong), ZIRKLE's solution, BENDA's solution (24 hours), BENDA's solution (chondriosome-method) or BENDA-ERLICKI's solution. The fixing mixtures which give a reaction-colour to the plastids together with the starch grains all contain chromic acid, with the exception of ALTMANN's solution, and the reaction-colour of the plastids may be partly due to the effect of chromic acid. The fixatives which give the deep reaction-colour for the starch grains contain chromic and acetic acid, and both of these may have some relation to that fact.

## 2) SPERMATIZOIDS

The spermatozoids which are fixed on a slide by gas flame or lamp heat preserve, in general, their morphological features even though their delicate structures are often destroyed. When they are stained with gentian violet, the nucleus, border-brim and lateral bar show a deep violet colour, while the cilia-bearing band and the cilia are faintly stained. Stained with HEIDENHAIN's iron-alum haematoxylin, however, the nucleus are stained homogeneously, although sometimes mottled, while the border-brim and lateral bars are stained somewhat faintly.

The structure of the spermatozoids which are air-dried and fixed on a slide by leaving in room-temperature suffers considerably. But the preservation of their morphological features is very good when they are fixed, according to the method described in the chapter "Materials and methods" (p. 146), with picric acid saturated in water; 2% aq. sol. of osmic acid (fume); 2% aq. sol. of osmic acid (fume) (bleached with hydrogen peroxide); formalin (commercial); 5% formalin; 5% acetic acid; 75% alcohol; FLEMMING's solution (Bonn); REGAUD's solution; JUNGERS' solution; sublimate-formalin solution; FLEMMING's solution (strong); BENDA-ERLICKI's solution; or formalin-CARNOY's fluid.

FLEMMING's solution (Bonn), REGAUD's solution, JUNGERS' solution, sublimate-formalin-solution, FLEMMING's solution (strong) and BENDA-ERLICKI's solution contain one or two of formalin, glacial acetic acid and osmic acid, and this gives a good fixation of the spermatozoids. The proportions of glacial acetic acid, osmic acid and formalin to 100 c.c. dist. water in these fixatives is 0.05–2.5 c.c. 0.02–0.2 gm. and 8.7–12 c.c. respectively as shown in TABLE VIII.

JUNGERS' solution contains picric acid and formalin, which are good for fixing the spermatozoid; and formalin-CARNOY's fluid containing formalin, glacial acetic acid and absolute alcohol, also gives a good fixation, so that in these cases, the good fixation must have been due to the picric acid, formalin, glacial acetic acid or absolute alcohol.

TABLE VIII

Fixative	Quantity of osmic acid to 100 c.c. dist. water in the fixative	Quantity of glacial acetic acid to 100 c.c. dist. water in the fixative	Quantity of formalin to 100 c.c. dist. water in the fixative
FLEMMING's solution (Bonn)	0.02 gm.	0.06 gm.	
FLEMMING's solution (strong)	0.2 gm.	0.05 gm.	
ZIRKLE's solution		2.5 gms.	
REGAUD's solution			8.7 c.c.
JUNGERS' solution			12 c.c.
Sublimate-for- malin solution			12 c.c.
BENDA-ERLICKI's solution	0.2 gm.	0.1 gm.	

Glacial acetic acid, osmic acid or formalin in the above-mentioned proportions, namely 0.1% aq. sol. of osmic acid, 10% formalin or 1% acetic acid, must result in good fixation. Indeed a good fixation of spermatozoid can be achieved by using these fixatives, with the exception of the 1% acetic acid as shown in TABLE IX.

TABLE IX

Fixatives	Stained with gentian violet.	Stained with HEIDENHAIN's iron-alum haematoxylin.
0.1% aq. sol. of osmic acid	Good fixation. Somewhat deep staining. Not complete differentiation of border-brim, lateral bar, cilia-bearing band or nucleus etc.	Good fixation. Somewhat deep staining. Good staining. Good differentiation.
10% aq. sol. of formalin	Good fixation. Good staining. Good differentiation.	Good fixation. Good staining. Good differentiation.
1% acetic acid	Good staining and differentiation. Cilia and cilia-bearing band tend to be destroyed.	Good staining and differentiation. Cilia and cilia-bearing band tend to be destroyed.

### A) HEIDENHAIN's iron-alum haematoxylin staining

The nucleus of the spermatozoid always stains deeply, but it shows a patchy structure when it is fixed by gas flame, lamp heat or corrosive sublimate saturated in water. When the spermatozoid is fixed with absolute alcohol, its nucleus often shows a granular structure. The border-brim is always stained, but somewhat fainter than the nucleus. The lateral bar which is directly connected with the border-brim always shows the same stainability as the latter. The cilia-bearing band is not stained in most of the cases, but stained when it is fixed with 3% aq. sol. of potassium bichromate; 2% aq. sol. of osmic acid; 3% aq. sol. of trichlor-acetic acid; acetone; 1% aq. sol. of uric acid; corrosive sublimate saturated in water; glacial acetic acid; 95% alcohol; 75% alcohol; 50% alcohol; 1% aq. sol. of chromic acid; chrom-acetic acid solution (strong); FLEMMING's solution (Bonn); MEVES' solution, LA COUR's solution; BENDA's solution; ALTMANN's solution; FLEMMING's solution (strong); BENDA's solution (chondriosome-method); or FLEMMING's solution (weak). The cilia are stained when the spermatozoid is fixed with picric acid saturated in water; 3% aq. sol. of potassium bichromate; 2% aq. sol. of osmic acid; 3% trichlor-acetic acid; 5% acetic acid; 1% aq. sol. of chromic acid; ether; chrom-acetic acid solution (strong); FLEMMING's solution (Bonn); MEVES' solution; LA COUR's solution; ZIRKLE's solution; BOUIN's solution; BOUIN-ALLEN's solution; MEVES' solution (chondriosome-method); CHAMPY's solution; sublimate-formalin solution; BENDA's solution; ALTMANN's solution; chrom-acetic acid solution (strong) + dist. water; FLEMMING's solution (weak); BENDA-ERLICKI's solution; ZENKER's solution, or KAISER's solution. The results are shown in TABLE X, 1st column.

### B) Gentian violet staining

The nucleus, border-brim and lateral bar are always stained with gentian violet. The cilia are also stained with gentian violet, except when the spermatozoid is fixed with BENDA's solution, BENDA's solution (chondriosome-method) or FLEMMING's solution (weak). The cilia-bearing band is stained faintly when the spermatozoid is fixed by lamp heat or gas heat or with 3% aq. sol. of potassium bichromate; 2% aq. sol. of osmic acid; acetone; 1% aq. sol. of urea; 1% aq. sol. of uric acid; formalin (commercial); 5% formalin; 1% aq. sol. of chromic acid; 3% nitric acid; ether; CARNOY's fluid (6:3:1); FLEMMING's solution (Bonn); LA COUR's solution; ZIRKLE's solution; BOUIN's solution; GILSON's solution; MEVES' solution (chondriosome-method); ALTMANN's solution; BENDA's solution (chondriosome-method); BENDA-ERLICKI's solution; formalin-CARNOY's fluid; ZENKER's solution or KAISER's solution.



TABLE X Fixation and staining of the spermatozoid of *Dryopteris uniformis* MAKINO (dry preparation-method)

Fixatives	1					2					3				
	HEIDENHAIN'S iron-alum haematoxylin staining					Gentian violet staining					FEULGEN'S nucleal-staining				
	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus
Lamp heat	+++	—	+++	—	+++	+++	+	+++	+	+++	—	—	—	—	+++
	The spermatozoid is somewhat damaged, but preserves its general morphological features. Staining is not sufficient.					The spermatozoid is somewhat damaged.									
Gas heat	+	—	+	—	++	+++	+	+++	+	+++	—	—	—	—	+++
	Nucleus is stained mottled, not homogeneous.					The spermatozoid is somewhat damaged.									
Picric acid saturated in water	+++	—	+++	+++	+++					+++	—	—	—	—	++
	Good fixation and staining.					Cilia, border-brim, cilia-bearing band, and lateral bar are destroyed.									
3% aq. sol. of potassium bichromat	+	+	+	+	+++	++	+	++	+	+++	—	—	—	—	+++
	Destroyed and stained homogeneously.					Good fixation and staining, deep but inadequate.					Border-brim and lateral bar often appear to be stained.				
2% aq. sol. of osmic acid (fume) (without bleaching)	++	+	++	+	++++	+++	++	+++	++	++++	—	—	—	—	+++
	Good fixation and staining.					Good fixation and staining, deep but inadequate.					Border-brim and lateral bar often appear to be stained.				



TABLE X (Continued)

		1					2					3				
Fixatives	HEIDENHAIN'S iron-alum haematoxylin staining					Gentian violet staining					FEULGEN'S nuclear-staining					
	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus	
2% aq. sol. of osmic acid (fume)	++	-	-	-	++++	+++	±	+++	++	++++	-	-	-	-	+	
	Good fixation and staining.					Good fixation and deep staining.										
3% aq. sol. of trichloroacetic acid	++	+	++	+	+++					+++	-	-	-	-	++	
	Destroyed.					Cilia, cilia-bearing band, lateral bar and border-beim are destroyed.										
Acetone	+++	+	+++	-	++++	++	+	++	+	++	-	-	-	-	+++	
						Inadequate fixation, destroyed.										
1% aq. sol. of urea	++	-	++	-	+++	+++	+	+++	+	+++	-	-	-	-	+++	
	Basal swollen points are stained.					Inadequate fixation.										
1% aq. sol. of uric acid	++	+	++	-	+++	++	+	++	+	+++	-	-	-	-	+++	
						Swells somewhat.										

TABLE X (Continued)

	1					2					3				
Fixatives	HEIDENHAIN'S iron-alum haematoxylin staining					Gentian violet staining					FEULGEN'S nuclear-staining				
	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus
Corrosive sublimate saturated in water	++	+	++	—	++	++	—	++	+	+++	—	—	—	—	+++
	Nucleus is often stained mottled.					Good fixation and staining.					Border-brim and lateral bar often appear to be stained.				
Formalin (commercial)	±	—	±	—	+++	++++	±	++++	++	++++	—	—	—	—	+++
	Good fixation and staining.					Shrinks somewhat.					Border-brim and lateral bar often appear to be stained.				
5% formalin	+++	—	+++	—	+++	+++	±	+++	++	+++	—	—	—	—	+++
	Good fixation and staining.					Good fixation and staining.									
Glacial acetic acid	+++	+	+++	—	+++					+++	—	—	—	—	+++
	Spermatozoid-body is often uncoiled.					Cilia, cilia-bearing band, lateral bar and border-brim are destroyed. Spermatozoid-body is often uncoiled.									
5% acetic acid	+++	—	+++	+	+++	+++	—	+++	++	+++	—	—	—	—	+++
	Good fixation and staining.					Good fixation and staining.									

TABLE X (Continued)

Fixatives	1					2					3					
	HEIDENHAIN'S iron-alum haematoxylin staining					Gentian violet staining					FEULGEN'S nuclear-staining					
	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus	
Absolute alcohol	++	-	+	+	++	+	-	+	+	++	-	-	-	-	++++	
	Nucleus often shows a granulous structure.					Often destroyed. Somewhat deep staining.										++++
95% alcohol	+++	+	+++	-	+++	+	-	+	+	+	-	-	-	-	++++	
	Destroyed.					Destroyed. Faint homogeneous staining.										++++
7% alcohol	+++	+	+++	-	+++	+	-	+	+	+	-	-	-	-	++++	
	Rather good fixation.					Destroyed.										++++
50% alcohol	++	+	++	-	+++	+	-	+	+	++	-	-	-	-	++++	
						Destroyed. Faint, homogeneous staining.										++++
30% alcohol																++++
	Cilia, cilia-bearing band, lateral bar and border-brim are destroyed. Spermatozoid-body is extended.					Cilia, cilia bearing band, lateral bar and border-brim are destroyed. Spermatozoid-body is extended. Faint staining.										++++

TABLE X (Continued)

Fixatives	1					2					3				
	HEIDENHAIN'S iron-alum haematoxylin staining					Gentian violet staining					FEULGEN'S nucleal-staining				
1% aq. sol. of chromic acid	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nu- cleus	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nu- cleus	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nu- cleus
	+	+	+	+	+++	+	+	+	+	+++	—	—	—	—	++
	Destroyed.					Destroyed.									
Ether	++	—	++	+	+++	+++	+	+++	++	+++	—	—	—	—	+++
	Nucleus is stained mottled.					Destroyed.									
3% nitric acid					++	+	+	+	+	++	—	—	—	—	+
	Cilia, cilia-bearing band, lateral bar and border-brim are destroyed. Spermatozoid-body is extended.														
	+++	—	+++	—	++++	++	—	++	+	+++	—	—	—	—	+++
ZENKER'S solution (without acetic acid)						Good fixation. Rather faint staining.									
CARNOY'S fluid (5:3:1)	+	—	—	—	+++	+++	+	+++	+	+++	—	—	—	—	+++
	Swells.					Destroyed.									



TABLE X (Continued)

Fixatives	1					2					3				
	HEIDENHAIN'S iron-alum haematoxylin staining					Gentian violet staining					FEULGEN'S nucleal-staining				
	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nu- cleus	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nu- cleus	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nu- cleus
Chrom-acetic acid solution (strong)	++	+	+-	+	+++						-	-	-	-	++
FLEMING'S solution (Bonn)	+++	+	+++	+	+++	±	±	±	±	±	-	-	-	-	+
	Good fixation and staining.					Destroyed. Almost unstained.									
MEVES' solution	+	+	+	+	+++					++	-	-	-	-	+++
						Cilia, cilia-bearing band, lateral bar and border-brim are destroyed.									
LA COUR'S solution	+	+	+	+	++	+	+	+	+	++	-	-	-	-	++
	Cilia, cilia-bearing band, lateral bar and border-brim are destroyed.					Destroyed.					Border-brim and lateral bar appear to be stained.				
ZIRKLE'S solution	+	-	+	+	++	+	+	+	+	+	-	-	-	-	+++
	Good fixation and faint staining.					Inadequate fixation. Destroyed.									

TABLE X  
(Continued)

Fixatives	HEIDENHAIN'S iron-alum haematoxylin staining					Gentian violet staining					FEULGEN'S nuclear-staining				
	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus
BOUIN'S solution	++	-	++	+	++++	++	+	++	+	++	-	-	-	-	+++
	Cilia are destroyed.														
BOUIN-ALLEN'S solution	++	-	++	+	++++										+++
	Cilia, cilia-bearing band, lateral bar and border-brim are hardly differentiated.														
REGAUD'S solution	+++	-	+++	-	+++	++	-	++	+	++	-	-	-	-	+
	Good fixation and staining.														
GILSON'S solution	+++	-	+++	-	+++	+	+	+	+	++	-	-	-	-	++
	Inadequate fixation. Faint staining.														
JUNGES' solution	+++	-	+++	-	++++	++	-	++	+	+++	-	-	-	-	+++
	Good fixation and staining. Basal swollen points are stained. Border-brim and lateral bar often appear to be stained.														

TABLE X (Continued)

Fixatives	1					2					3				
	HEIDENHAIN'S iron-alum haematoxylin staining					Gentian violet staining					FEULGEN'S nucleal-staining				
	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus
MEYER'S solution (chondriosome method)	+++	-	+++	+	++++	±	±	±	±	±	-	-	-	-	++
	Cilia and cilia-bearing band are destroyed.					Destroyed. Almost unstained.									
CHAMPY'S solution	+++	-	+++	+	++++	++	-	++	+	++	-	-	-	-	+
						Good fixation. Inadequate staining.									
Sublimed-formalin solution	+++	-	+++	+	++++	+++	-	+++	+	+++	-	-	-	-	++++
	Good fixation and staining. Granules in the spermatid-cytoplasm are stained.					Good fixation and staining.									
BENDA'S solution	+	+	+	+	++	+	-	+	-	+++	-	-	-	-	+
						Good fixation. Cilia are destroyed.					Nucleus is stained very faintly. Starch grains in the spermatid-cytoplasm are stained reddish.				
ALTMANN'S solution	+++	+++	+++	+++	+++	+++	+	+	+	+++	-	-	-	-	++
	All the portions of the spermatozooids are black.														

TABLE X (Continued)

Fixatives	1				2				3						
	HEIDENHAIN'S iron-alum haematoxylin staining				Gentian violet staining				FEULGEN'S nucleal-staining						
	Border-brim band	Cilia-bearing band	Lateral bar	Cilia	Nucleus	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus
FLEMING'S solution (strong)	++	+	++	—	+++	+		+		++	—	—	—	—	++
	Rather good fixation and staining.					Cilia and cilia-bearing band are destroyed.									
Chrom-acetic acid solution + dist. water (1:1)	+	—	+	+	+++						—	—	—	—	+
						Destroyed. Faint staining.									
BENDA'S solution (chondriosome-method)	+++	+	+++	—	+++	+	+	+	—	+++	—	—	—	—	+++
	Basal swollen points are stained.														
FLEMING'S solution (weak)	+	+	+	+	++	+	—	+	—	++	—	—	—	—	++
	Cilia, cilia-bearing band, lateral bar and border-brim are destroyed.					Cilia are destroyed. Shrinks somewhat.									
BENDA-ERLICKI'S solution	++	—	++	+	+++	+	+	+	+	+	—	—	—	—	—
	Good fixation and staining.					Destroyed.					Border-brim and lateral bar often appear to be stained.				



TABLE X (Continued)

Fixatives	1			2			3		
	HEIDENHAIN'S iron-alum haematoxylin staining			Gentian violet staining			FEULGEN'S nucleal-staining		
	Border-brim	Cilia-bearing band	Lateral bar	Cilia	Nucleus	Border-brim	Cilia-bearing band	Lateral bar	Nucleus
CARROY'S fluid (3:1)	+	+	+	+	+	+	+	+	+
	Cilia, cilia-bearing band, lateral bar and border-brim are destroyed.			Cilia and cilia-bearing band are destroyed.					
Formalin-CARROY'S fluid	+	+	+	+	+	+	+	+	+
	Good fixation and staining.			Destroyed.					
ZENKER'S solution	+	+	+	+	+	+	+	+	+
	Granules in the spermatid-cytoplasm are stained deeply.			Destroyed.					
KAISERS'S solution	+	+	+	+	+	+	+	+	+
	Cilia, cilia-bearing band, lateral bar and border-brim are easily destroyed.								

++++ = Very deeply stained.

+++ = Deeply stained.

++ = Lightly stained.

+ = Very lightly stained.

± = Very lightly stained or unstained (ambiguous case).

- = Unstained.

The most beautiful fixation and staining with gentian violet are obtained when the spermatozooids are fixed with 2% aq. sol. of osmic acid (fume), corrosive sublimate saturated in water, 5% formalin, 5% acetic acid or sublimate-formalin solution. The results of the staining obtained are shown in TABLE X, 2nd column.

### C) FEULGEN's nucleal-staining

It was shown by the writer (1935) that the nuclei of the spermatozooids of *Adiantum capillus-veneris* L., *Matteuccia orientalis* L., *Athyrium nipponicum* HANCE, *Salvinia natans* HOFF., and *Isoetes japonica* AL. BR. always react positively towards FEULGEN's nucleal-staining, while the border-brim, lateral bar, cilia-bearing band and cilia react negatively.

In the case of *Dryopteris uniformis* the nucleus of the spermatozoid also shows positive FEULGEN's nucleal-reaction and stains homogeneously violet, but sometimes, according to the fixative used, it shows a granular structure or contains many small vacuoles. The deep reaction-colours are obtained when the spermatozoid is fixed by gas heat; lamp heat; 3% aq. sol. of potassium bichromate; 3% aq. sol. of osmic acid (fume); corrosive sublimate saturated in water; formalin (commercial); glacial acetic acid; 5% acetic acid; 95% alcohol; 30% alcohol; CARNOY's fluid (6:3:1); sublimate-formalin solution or formalin-CARNOY's fluid (TABLE X, 3rd column).

The border-brim is negative towards FEULGEN's nucleal-reaction but sometimes it appears to be positive when the spermatozoid is fixed with 3% aq. sol. of potassium bichromate; 2% aq. sol. of osmic acid (fume), corrosive sublimate saturated in water; formalin (commercial); LA COUR's solution; REGAUD's solution; JUNGERS' solution or BENDA-ERLICKI's solution.

When the prothallium, which bears antheridia is sectioned by the paraffin-method after fixation with various fixatives and is treated with FEULGEN's nucleal-staining, the nucleus of spermatozoid also shows a positive reaction (TABLE VII, 6th column).

## General considerations and discussion

As YAMAHA (1936) stated, the so-called good fixation of protoplasm did not necessarily mean that state in which protoplasm was preserved nearest to the living structure: it rather meant that the protoplasm-structures were preserved in a most suitable state for observation. On the other hand, it is very important and necessary in cytological and morphological study to compare the protoplasm-structure, which has been found in the most suitable state for observation from the view point of cytomorphology, with that in living state, and to distinguish the various

protoplasm-structures. From this point of view, in the present study the writer concluded that the fixative which preserve the protoplasm-structure in most suitable state for observation from the cytomorphological view-point, with little shrinkage or swelling of cells, should be good ones and he went on further to study their respective effects in fixing and staining technique.

The general structure, especially the nucleus, of the sporophytic and prothallium-cells is preserved and stained with HEIDENHAIN's iron-alum haematoxylin in most suitable state for observing when it is fixed with a fixing solution containing chromic acid and acetic acid in the following proportions to 100 c.c. dist. water: 0.4 gm. <chromic acid<1 gm., 1.4 c.c. <acetic acid<3 c.c. Moreover the fixative which is composed of only chromic acid, acetic acid and 100 c.c. dist. water in the above-mentioned proportion also proves to be a good fixative. In this case the acetic acid seems first to invade the tissue (c.f. ZIRKLE 1928) and to facilitate the entrance of the chromic acid.

On the basis of the experiments it is supposed that good fixation and staining with HEIDENHAIN's iron-alum haematoxylin of cytoplasm can result from that fixative which contains chromic acid or potassium bichromate or both of these reagents to 100 c.c. dist. water, in the following proportions: 0.2 gm. <chromic acid<0.8 gm., 0.6 gm. <potassium bichromate<2.7 gms. Indeed 0.5% aq. sol. of chromic acid gives a good fixation and staining of cytoplasm. The other experiments, however, shows that it is not sufficient for good fixation and staining of cytoplasm to have potassium bichromate or potassium bichromate and chromic acid in the fixative only. According to ZIRKLE (1928), bichromate only preserves mitochondria and cytoplasm when the pH of the fixative is on the alkaline side, and in the fixation of cytoplasm the pH of the fixatives should be carefully taken into consideration, to say nothing of the joint action of chromic acid and potassium bichromate.

Good fixation and staining with HEIDENHAIN's iron-alum haematoxylin of plastids result from a fixative which contains osmic acid and chromic acid or osmic acid and potassium bichromate or three of them in the following proportions to 100 c.c. dist. water: 0.4 gm. <chromic acid<0.6 gm., 1.2 gm. <potassium bichromate<2.5 gms., 0.2 gm. <osmic acid<1 gm. For the mitochondria good results can be obtained from a fixative which contains chromic acid and osmic acid or osmic acid, chromic acid and potassium bichromate in the following proportion in 100 c.c. dist. water: 0.2 gm. <osmic acid<0.4 gm., 0.4 gm. <chromic acid<0.6 gm., 1.2 gm. <potassium bichromate<1.3 gm.

Therefore for the good fixation and staining with HEIDENHAIN's iron-alum haematoxylin of plastids and mitochondria, osmic acid is regarded

as a necessary constituent, supported by the action of chromic acid or potassium bichromate.

According to YAMAHA (1932) the stainability of the fixed protoplasm-structure in the root-tip-cells of *Vicia Faba* is greatly affected by the fixative employed. CARLSON (1936) also stated that in the root-tip-cells of *Zea Mays* that the stainability of the different cell-structure when stained with HEIDENHAIN's iron-alum haematoxylin, crystal violet or safranin-iodine is conditioned directly by the fixatives. These authors have made Dicotyledoneae and Monocotyledoneae for their materials of study, while the writer confirmed the same fact with Pteridophyta and showed that the stainability of sporophytic cells and prothallium-cells with HEIDENHAIN's iron-alum haematoxylin is affected by the fixative employed. So that, as stated above, the adequate fixative should be selected for the staining of each of the cell-elements.

The positive nucleal-reaction of the nuclei of Pteridophyta has been shown in *Aspidium* sp. (fixed with BOUIN's solution) by WESTBROOK (1930) and in the prothallium of *Athyrium nipponicum*, the leaves of *Equisetum hiemale* and *Azolla japonica* (fixed with KAISER's solution) by YAMAHA (1935). In the present case of *Dryopteris uniformis* the nucleal-reaction of the nuclei of the sporophytic cells and prothallium-cells is also positive. The nuclei of sporophytic cells, however, show negative nucleal-reaction when they are fixed with chrom-acetic acid solution or CHAMPY's solution (fixed for 48 hours) and subjected to FEULGEN's nucleal-reaction according to the paraffin-method, while those of spore-mother-cells show a negative reaction when fixed with CHAMPY's solution (fixed for 48 hours) as did the prothallium-cells when fixed with 1% aq. sol. of chromic acid, chrom-acetic acid solution (strong) or CHAMPY's solution (fixed for 24 or 48 hours).

In some ferns the nuclei of sporophytic leaf-cells show a negative nucleal-reaction when they are fixed with an aq. sol. of chromic acid of a limited percentage (YUASA 1937). In this case the nucleal-reaction is also affected by the fixation-time. In the present case of *Dryopteris uniformis* the negative reaction must be partly due to the action of the chromic acid which is contained in the fixative.

YAMAHA (1932) showed in the root-tip-cells of *Vicia Faba* that the nuclei are negative towards FEULGEN's nucleal-reaction when they are fixed with MERKEL's solution, BOUIN's solution, or ZENKER's solution, and subjected to the nucleal-reaction after being treated by the paraffin-method. These fixatives except MERKEL's solution contain no chromic acid, so these cases negative character of the nucleal-reaction may be due to some factors other than chromic acid. Judging from these facts it is suggested that the nuclei of *Dryopteris uniformis* are in a different condi-



tion from the nuclei of *Vicia Faba* and are also affected by other factors than those which affect the nuclei of the latter.

CARLSON (1936) stated, regarding the root-tip-cells of *Zea mays*, that the intensity of the FEULGEN's nucleal-staining is conditioned by the fixative employed. In the present study the same results are obtained in the sporophytic and prothallium-cells of *Dryopteris uniformis*. As stated above, chromic acid exerts a great influence upon the nucleal-reaction in *Dryopteris uniformis* and, in some cases, even makes the nuclei show a negative nucleal-reaction. The variations of nucleal-reaction according to the different fixative employed may be partly due to the action of chromic acid.

YAMAHARA (1932) supposed that the reaction-colour of the cell-membrane in the nucleal-reaction of some of bryophytic and pteridophytic plants might be due to the desoxypentose which is contained in the cell-membrane. CARLSON (1936) observed the variations of the reaction colour of the cuticle in the tracheid membrane of *Zea Mays*. In the present study the tracheid-membrane always shows a reaction-colour whatever fixative is used for the fixation. The cell-membrane, plastids and starch grains show or do not show a reaction-colour according to the fixative used and yet show a reaction-colour even when fixed by a fixative which gives a negative reaction of the nuclei. Therefore the reaction-colour of the cell-membrane, plastids and starch grains may be due to different substances from the thymonucleic acid in the nucleus, and also to the effect of the fixative employed.

Though the staining of spermatozoid with HEIDENHAIN's iron-alum haematoxylin has been tried by various authors (BELAJEFF 1888, SHAW 1898, CAMPBELL 1907, YAMANOUCHI 1909, ARNOLDI 1910, SHARP 1912, 1914, ALLEN 1914, YUASA 1933 a, b, c, 1935), the effect of the fixative on the staining has not yet been studied. In the present study, however, the writer confirmed that the staining mode of spermatozoid with HEIDENHAIN's iron-alum haematoxylin or gentian violet was also affected by the fixative employed, and determined a good fixative for the cytomorphological study of spermatozooids.

The positive nucleal-reaction of the nucleus of spermatozoid was shown by the writer (1935) in some ferns, *Salvinia natans* and *Isoetes japonica* and by MILOVIDOV (1936) in *Equisetum hiemale*. In the present study the positive nucleal-reaction of the nucleus of the spermatozoid was also confirmed by the writer in *Dryopteris uniformis*, whatever fixative was used. The reaction-colour was, however, affected by the fixative employed. In this case, chromic acid might exert a great influence on the reaction-colour as in the case of the sporophytic cells and prothallium-cells.



The border-brim, cilia-bearing band, lateral bar and cilia show a negative nucleal-reaction. The border-brim, however, shows a faint reaction-colour when fixed with 3% aq. sol. of potassium bichromate, 2% aq. sol. of osmic acid (fume), corrosive sublimate saturated in water, formalin, LA COUR's solution, REGAUD's solution, JUNGERS' solution or BENDA-ERLICKI's solution. This fact may be explained by assuming that thymonucleic acid in the spermatozoid-nucleus permeates into the border-brim, that some aldehyde which shows a positive reaction towards FEULGEN's nucleal-reaction is set free in the border-brim or that the reaction-colour of osmic acid or the colour of potassium bichromate, picric acid or chromic acid remains in the border-brim.

As seen from above, chromic acid performed great rôle in the cytological study of *Dryopteris uniformis*. It proves to be a good fixative, but at the same time it has varying effects on fixation and staining; so that investigators should be careful in employing chromic acid in the cytological study of Pteridophyta.

### Summary

1. It is the writer's opinion that any fixative which preserves the cell structures in the most suitable state for observation from the cytomorphological view point without resulting shrinkage or swelling of cells, when stained with HEIDENHAIN's iron-alum haematoxylin, is a good fixative. In the present study sporophytic leaves and prothalliums of *Dryopteris uniformis* MAKINO were used as material.

2. The fixative which results in the best fixation and staining when using HEIDENHAIN's iron-alum haematoxylin was determined in the sporophytic cells and prothallium-cells. It was also determined what component of the fixative or what quantity of the component can ensure good fixation followed by the good staining. The effect of the fixative employed was also studied in the nucleal-reaction of the nuclei of sporophytic cells, prothallium-cells, spore-mother-cells and spermatids when the nuclei were subjected to the reaction according to the paraffin-method. The effect of the fixative on the nucleal-reaction of the spermatozoid was also ascertained by employing the paraffin-method or smear-method. A study was also carried out in regard to the good fixation and staining of spermatozoid and the effects of the fixative on the staining.

3. The fixatives which result in good fixation and staining of the general structures of the cell especially the nucleus with HEIDENHAIN's iron-alum haematoxylin are 2% aq. sol. of osmic acid, 1% aq. sol. of urea, 1% aq. sol. of chromic acid, chrom-acetic acid solution (strong), FLEMING's solution (Bonn), MEVES' solution (12 hours), ZIRKLE's solution,

GILSON's solution and chrom-acetic acid solution + dist. water (1:1). The fixing mixtures of all these fixatives contain chromic acid whose action seems to be necessary for good fixation and staining. Glacial acetic acid seems also to have good effects for the fixation and staining of the general structure of the cell, especially the nucleus. The quantity of chromic acid and acetic acid in 100 c.c. dist. water in the fixatives which give good fixation and staining is 0.4–1 gm. and 1.4–3 c.c. respectively.

4. Good fixation and staining with HEIDENHAIN's iron-alum haematoxylin of cytoplasm result from 3% trichlor-acetic acid, corrosive sublimate saturated in water, REGAUD's solution, JUNGERS' solution, MEVES' solution (chondriosome-method), CHAMPY's solution (48 hours), BENDA's solution (chondriosome-method), FLEMMING's solution (weak) or BENDA-ERLICKI's solution. In these cases the chromic acid and potassium bichromate in the fixatives seem to have a good effect on the fixation and staining. In these fixatives chromic acid and potassium bichromate are contained in 100 c.c. dist. water in the proportion of 0.2–0.8 gm. and 0.6–2.7 gms. respectively. From other experiment, however, it is ascertained that a good fixation and staining of cytoplasm can be obtained from aq. sol. of chromic acid or the joint action of chromic acid, potassium bichromate and the other components.

5. For the fixation and staining of plastids with HEIDENHAIN's iron-alum haematoxylin good results are obtained by employing MEVES' solution (12 hours), ZIRKLE's solution, MEVES' solution (chondriosome-method), CHAMPY's solution (24 or 48 hours), BENDA's solution (24 hours), ALTMANN's solution or BENDA-ERLICKI's solution. The good fixation and staining with HEIDENHAIN's iron-alum haematoxylin can be obtained from a fixative which contains both osmic acid and chromic acid, both osmic acid and potassium bichromate or all three, osmic acid, chromic acid, and potassium bichromate in 100 c.c. dist. water in the following proportions: 0.2 gm. < osmic acid < 1 gm., 0.4 gm. < chromic acid < 0.6 gm., and 1.2 gm. < potassium bichromate < 2.5 gms.

6. For the fixation and staining of mitochondria with HEIDENHAIN's iron-alum haematoxylin good results are obtained by employing MEVES' solution (chondriosome-method), CHAMPY's solution (24 or 48 hours), BENDA's solution (24 hours) or BENDA-ERLICKI's solution. Good fixation and staining of mitochondria can result from a fixative which contains osmic acid and chromic acid in the proportion of 0.2–0.4 gm. and 0.4–0.6 gm. to 100 c.c. dist. water respectively as well as a fixative which contains osmic acid, chromic acid and potassium bichromate in the proportion of 0.2–0.4 gm., 0.4–0.6 gm. and 1.2–1.3 gm. to 100 c.c. dist. water.

7. For the study of sporogenesis the use of chrom-acetic acid solution (strong), chrom-acetic acid solution + dist. water (1:1), CARNOY's

fluid (3:1) or formalin-CARNOY's fluid is recommended; and for the study of spermatogenesis ZENKER's solution (without acetic acid), FLEMMING's solution (weak), chrom-acetic acid solution or chrom-acetic acid solution + dist. water (1:1).

8. The unstaining of the nucleus of the material which has been fixed with JUNGERS' solution, CHAMPY's solution or BENDA-ERLICKI's solution may be due to the joint action of the components. In the case of MEVES' solution, however, the failure of the nuclei to stain may be due to the action of NaCl.

9. A fixative which contains a large quantity of acetic acid results in the staining of the sindle.

10. The nucleal-reaction of the nuclei of sporophytic cells and prothallium-cells is affected by the fixation-time and the percentage of chromic acid which is contained in the fixative.

11. The tracheid-membrane of leaf-cell and prothallium-cell always shows a reaction-colour in the nucleal-staining, whatever fixative is used for its fixation. The cell-membrane, plastids and starch grains also show a reaction-colour when a certain fixative is used for their staining. These reaction-colours are thought to be due to the presence of some substance different from thymonucleic acid or the effect of the fixative used.

12. The best fixation of the spermatozoid is obtained by using picric acid saturated in water, 2% osmic acid (fume), 2% osmic acid (fume) (without bleaching), formalin, 5% formalin, 5% acetic acid, 75% alcohol, FLEMMING's solution (Bonn), ZIRKLE's solution, REGAUD's solution; JUNGERS' solution, sublimate-formalin solution, FLEMMING's solution (strong), BENDA-ERLICKI's solution or formalin-CARNOY's fluid. These fixing mixtures contain one or two of osmic acid, chromic acid, acetic acid, picric acid and formalin which seems to give a good fixation of the spermatozoid.

13. The fixatives shown in the above-paragraph (12) also give the best staining of the spermatozoid with HEIDENHAIN's iron-alum haematoxylin and the best differentiation of the spermatozooids.

14. The best fixation followed by the best staining with gentian violet of spermatozoid can be produced by 2% osmic acid (fume), corrosive sublimate saturated in water, 5% formalin, 5% acetic acid or sublimate-formalin.

15. The nucleus of the spermatozoid of the dried preparation always shows a positive nucleal-reaction whatever fixative is used. The reaction-colour is, however, affected by the fixative used.

16. The border-brim, cilia-bearing band, lateral bar and cilia show a negative nucleal-reaction. The border-brim, however, shows a very faint

reaction-colour by FEULGEN's nucleal-staining when fixed with certain fixatives, but the reaction-colour may not be due to thymonucleic acid.

The writer wishes to express his sincere thanks for the valuable aid given by Director Dr. H. HATTORI of the Tokugawa Institute for Biological Research. He is also particularly indebted to Professor Y. SINOTÔ of Tokyo Imperial University for his valuable suggestions and criticism during the course of this work.

The expense for carrying out this study was partly defrayed out of a grant from "Nippon-Gakuzyutu-Sinkôkai" (The Japan Society for the Promotion of Science) to which body the writer wishes to express his best thanks.

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# Anatomy and morphology of *Oleandra Wallichii* (HK.) PR., with some notes on the affinities of the genus *Oleandra*<sup>(1)</sup>

By Yudzuru OGURA

With 9 text-figures

(Received January 19, 1938)

## Introduction

The genus *Oleandra* is one of the Polypodiaceous genera, and is characterized by possessing 1) a creeping rhizome, 2) an articulate petiole, 3) undivided simple lamina, 4) free parallel veins, 5) a single sorus on the base of the vein, 6) a reniform indusium opened outside and 7) reniform spores. From these characteristics, it is believed that this genus stands near the Davallieae or the Aspidieae, but accurate studies on this fern genus seem to be still inadequate. The writer had recently an opportunity to collect *Oleandra Wallichii* in a botanical trip through Formosa, and found, from the anatomical and morphological points of view, very remarkable characteristics, which had been scarcely noticed by former authors. These characteristics were also found in some species of the genus, which were studied from dried materials, and may be recognised as special characters of the genus *Oleandra*. With these characters as a basis, the writer intends to discuss, from points of view other than what have hitherto been undertaken, the affinities of the genus.

## Anatomy and morphology of *Oleandra Wallichii* (HK.) PR.

*Oleandra Wallichii* is native to tropical Asia and the Malay Archipelago. The writer collected this species at Mt. Arisan in Formosa at the altitude of about 2300 m. At the time when the writer visited there, in December, 1936, it was the period of leaf-fall for this species, and some rhizomes were cultivated at Tokyo, where the leaves appeared in the next spring and the sporangia in early summer. The present study was based on the native as well as the cultivated materials.

*External characters.* At an altitude of about 2300 m. on Mt. Arisan, there are numerous giant trees. This fern occurs epiphytically on the high

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(1) Contributions from the Divisions of Plant-Morphology and of Genetics, Botanical Institute, Faculty of Science, Tokyo Imperial University, No. 205.

branches of such trees or on the humus near the ground. In the latter case it occurs intermingled with other plants or mosses. The slender stem, or rhizome, and its branches creep or climb on such a complicated substratum, not only horizontally but also vertically. The long slender roots spring out of the lower side of such a rhizome and penetrate through the hollow spaces of the substratum, until they reach suitable place, i.e. the humus or bark of tree, where they repeatedly give off branches. On the upper side of the rhizome the long simple leaves are arranged rather roughly; their petioles are articulate at their bases, and after leaf-fall one may see the remains of the petioles, as small protuberances, along the rhizome.

*Stem.* The stem or the rhizome is slender, 3–6 mm. in diameter, and elongates rapidly every year, putting forth branches to right and left sides. The writer could find a stem more than 1 m. in length. The rhizome shows



Fig. 1. *Oleandra Wallichii*; cross section of the rhizome, showing peltate scales and the arrangement of large and small meristemes.  $\times 7$

a dorsiventral character, because the leaves are arranged on its dorsal side, the roots on its ventral side, and the branches on its lateral sides, though their arrangement is not in every case regular. The arrangement of the leaves and branches is rather rough, so that the stem shows long internodal parts, and its cross section is therefore circular or elliptical. The writer, however, noticed that in most cases some leaves are attached to each other. Such an arrangement may be comparable with the verticillate form in some other species of the genus. The

branches grow mostly at right angles to the mother axis.

The rhizome is covered with dark brown scales of a long lanceolate form. They are peltate, the stalk being attached to the center of the broad side. This stalk is immersed in a small groove of the stem surface, just as in the case of *Davallia*, *Humata* or *Cyclophorus* (fig. 1).

In a cross section of the rhizome one may see a rather simple structure. Within the epidermis, which is of normal structure, is a wide fundamental tissue, constituted of parenchymatous cells of nearly the same form and size. Some layers under the epidermis consist sometimes, but not always, of rather thick-walled cells, which layers are comparable to the hypodermal ones in some other species of the genus. In some cases one may see cells with dark contents, that is, tannin cells; they occur mostly round the meristeme, but in some specimens they are quite absent.

One of the characteristic features in the stem is in the stelar system. It consists, in cross section, of some meristemes arranged in a circle, which

are differentiated into large and small. The large meristemes are five to seven, mostly five, in number, while one or two of the small ones are situated between two large ones, but none of the small ones can exist among the two, so that the small ones are four to nine in number in a cross section (fig. 1).

The structure of the meristeme, whether large or small, is simple, consisting of a bicollateral bundle surrounded by endodermis. The xylem consists of a mass of tracheids of from three to five layers.

In order to know the course of the large and small meristemes, serial sections of the rhizome were made and the model of the stelar system was reconstructed (fig. 2). If we consider the large ones alone, they are the

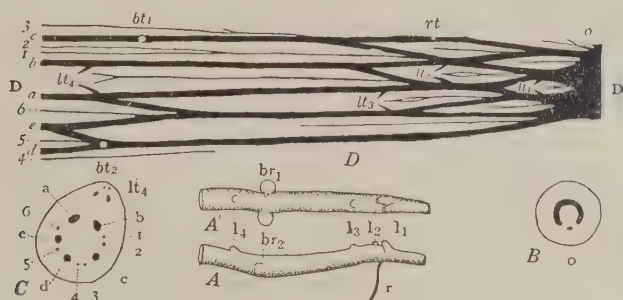


Fig. 2. *Oleandra Wallichii*; diagram showing the construction of the stelar system of the basal part of a branch shown in A. B, C, cross sections of the branch at its right (basal) and left (upper) ends; basal part shows solenostelic structure. D, diagram of stelar system developed in a plane, showing the course of large and small meristemes. *l*<sub>1</sub>-*l*<sub>4</sub>, leaves (*l*<sub>3</sub>, *l*<sub>4</sub> abortive), *br*<sub>1</sub>-*br*<sub>2</sub>, lateral branches (abortive), *o*, first small meristeme appeared in the solenostelic gap. *a-e*, *1-6*, large and small meristemes on the left end. *lt*<sub>1</sub>-*lt*<sub>4</sub>, leaf traces for the leaves *l*<sub>1</sub>-*l*<sub>4</sub>. *bt*<sub>1</sub>-*bt*<sub>2</sub>, branch traces for the lateral branches *br*<sub>1</sub>-*br*<sub>2</sub>. *r*, rhizophore. *rt* rhizophore trace. D-D, dorsal side of the rhizome. A, nat. size, B, C×3.5

main stelar system constructed in a dictyostelic type with long and broad gaps. Each small meristeme originates from the bottom of such a gap, runs within the gap between two large meristemes and is sometimes divided into two, which may further fuse again. Tracing such a small meristeme further on, it is very curious that in most cases it diminishes blindly without connecting with any other meristemes, while in some cases it enters the petiole as the middle one of the leaf traces, the lateral traces coming from the main meristemes directly at the petiolar base. Thus, the leaf traces consist usually of three strands, the median one of which, after running between main meristemes, originates from the small meristeme now under discussion, while the lateral ones come directly from the lateral

meristeles of the same gap. One or two of the leaf traces sometimes bifurcate or connect with each other, so that more than four traces are often met with. As previously stated, the leaves are usually situated on the dorsal side of the rhizome, so that we see in all the gaps on the dorsal side the formation of the leaf traces, while in those of the ventral side the small meristele diminish blindly. In the fern in general, when three leaf traces enter the petiole, the middle one originates from the bottom of the gap, and the lateral ones from the lateral sides of the same gap, as in the present fern, but it is very rare that the leaf traces run through such a long distance as in this fern; even when they are long, they are distinguished from the normal meristeles, such as those in *Davallia*. In this species the small meristele has the same structure with the large one, showing nothing in the nature of the leaf trace.

As for the nature of the small meristeles, one can consider them under two categories. First, if we consider them as a part of the stelar system of the stem, they may, after running a long distance, transform in the dorsal side of the rhizome into the leaf traces at the petiolar base, while on the ventral side they may diminish blindly; the stelar system is then one of the dictyosteles with perforations, such as the writer formerly described (OGURA 1938 b). Secondly, if we consider them as a part of the leaf traces, either entering the petiole or diminishing blindly, the stelar system may be merely a typical dictyostele, represented only by the large meristeles. A stelar system which is comparable with that of this fern is found in *Davallia*. In this case, it is well known that in a cross section of the rhizome there are two large meristeles, one on the dorsal side and the other on the ventral, which run straight through the rhizome along the dorsal and ventral sides, while the small ones on both sides of the former, three to five each in number, run through the internode, anastomosing with each other and with the large ones, and enter the petioles as a whole as leaf traces (METTENIUS 1863, ARBELÁEZ 1928, OGURA 1938 b). The behavior of these small meristeles as leaf traces is similar to that of the small meristeles in the present species, in which, however, they may diminish in some cases. In *Davallia* the small meristeles may be considered, at least in the internode, as part of the stelar system of the stem, and consequently the stelar system is to be considered as a perforated dictyostele. The same category may be applied to *Oleandra*, though the anastomosing with other meristeles is not to be seen, and, moreover, may diminish blindly. The stelar system may be considered therefore as a perforated dictyostele.

One of the other characteristics in the stelar system of this fern is that of the lateral branches, which possess the solenostelic form at their bases (fig. 2, B). The branch is situated, as before stated, usually at the lateral side of the rhizome, and the trace for it originates from one of the



large meristele, leaving a small gap in the latter, which may soon fill up. The branch trace thus detached is small and is a complete circular ring, which will soon elaborate conically, and the gaps will appear so as to form immediately a dictyostele, and then in the gap a small meristele will be formed (fig. 2, D). There are many protuberances on the stem, representing abortive leaves or branches. These two kinds of organs may be similar in appearance (fig. 2, A), but they are easily distinguished from each other by the difference of the steles among them.

The mode of departure of the root trace is rather simple, as it originates from one of the large meristele on the ventral side, as a small strand, leaving no gap on the meristele. The details of it will be described later.

*Leaf.* The leaf is very simple in form, as it consists of a short petiole and a long, undivided lamina. From the midrib lateral veins run to both sides, nearly parallel with each other. Each vein is undivided or divided once, rarely twice, and they run without connecting up with each other. It is near the base of this undivided vein that a sorus is situated (fig. 4). On the petiole and midrib are found small scales and short hairs, the latter being found also on the lateral veins as well as leaf margins.

The scales on the leaf are not peltate, the stalks being situated at their ends, and the hairs are uniseriate, consisting of a few cells.

The petiole is constructed in typical fern form; there is a thick and hard hypodermal layer, which is interrupted at the two lateral sides, and there are three or four meristele in the midst of the central parenchyma (fig. 3). Among these meristele the two adaxial ones are much larger than the others, and each of them contains a curved tracheidal group. The small ones, which are the continuation of the small meristele of the rhizome formerly described, divide or fuse with each other or with the large ones; the two latter finally, at the upper part of the midrib, fuse together into a vein, including a very flattened V- or x-formed tracheidal mass. This type of stelar system is a so-called *Polypodium*-type, as may

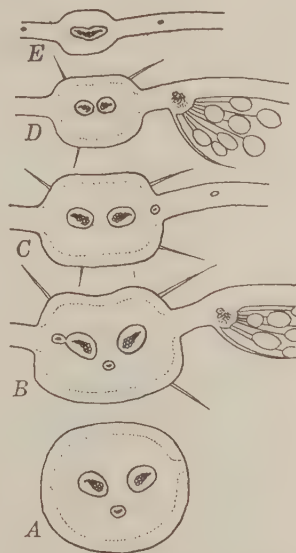


Fig. 3. *Oleandra Wallichii*; successive cross sections of the petiole (A) and midrib (B-E), showing the *Polypodium*-type of stelar system.  $\times 15$

be found in numerous ferns, such as *Nephrolepis*, *Davallia*, *Humata*, as well as *Polypodium*, *Cyclophorus* etc. (OGURA 1938 b).

The lamina is membranaceous and somewhat transparent, about 0.15 mm. in thickness. Its epidermis is of the normal type, the stomata being found only on the lower side. The mesophyll consists of several layers of roundish assimilating cells, which are on the lower side roughly arranged (fig. 4).

*Sorus*. The sorus is situated near the base of an undivided vein and is covered with a reniform indusium, about 0.7–0.8 mm. in lateral dia-

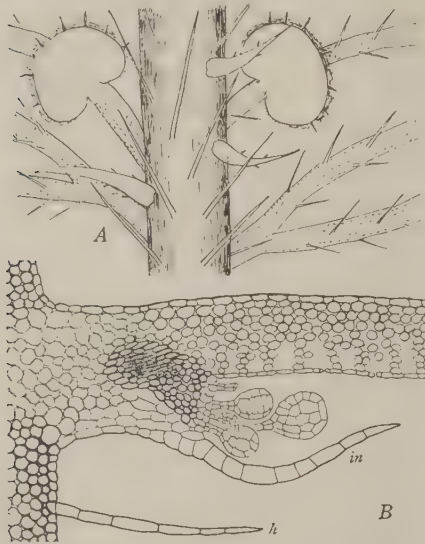


Fig. 4. *Oleandra Wallichii*; A, a part of the lower surface of the lamina, showing the position of sori (indusia) on the veins; scales and hairs on the midrib and veins. B, cross section of the former through a young sorus with sporangia in various developing stages.

A  $\times 15$ , B  $\times 70$

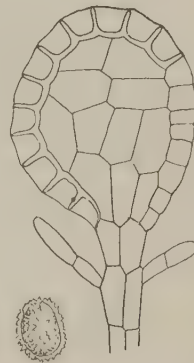


Fig. 5. *Oleandra Wallichii*; a sporangium and a spore.  $\times 150$  &  $300$

meter. The indusium is attached to a small receptacle rising somewhat from the lower side of the vein (fig. 4). Its median axis is at first parallel to the vein, but it may afterwards incline somewhat. In the receptacle are seen irregular cells with tracheidal sculpture. On the margin of the indusium are seen a few hairs consisting of a few cells. Sporangia are found on the receptacle and are of mixed type, that is, those in various stages of development are met with intermingled with each other (fig. 4, B).

Each sporangium is of a normal Polypodiaceous type; it has a long stalk, which is provided with one or three short paraphyses consisting of a few cells. The sporangium itself is, from a lateral view, circular or somewhat elliptical, about 0.2 mm. in lateral diameter, and the annulus is straight consisting of eleven to thirteen thick-walled cells (fig. 5). The spores are elliptical or somewhat reniform, about  $0.02 \times 0.04$  mm. in diameter, and their surface is sculptured with minute dentate coverings.

The study of the development of the spores and prothallium is now proceeding.

**Root.** One of the most characteristic features of this fern is in the root, for it is not a typical root, but is rather a rhizophore, like that seen in *Selaginella*. The roots, as they may be from their external appearance, depart mainly from the ventral side of the rhizome, and running undivided a long distance through the substratum of mosses or branches of other plants, reach the humus or the bark of the tree, where they put forth branches. This unbranched part is naked or covered with fine brown hairs and is naturally very variable in length, reaching sometimes a length of more than 10 cm. Even after reaching the humus they continue to elongate, branching out into fine lateral rootlets, so that their whole length may be further longer (fig. 6, A).

Near the apex of the rhizome or its branches one sees short roots just given off. Their apices are slightly greenish and are covered with fine brown hairs (fig. 6, B, D). These hairs are not, however, the typical root hairs, because each of them consists of several cells, sometimes giving forth branches. After the roots elongate, these hairs mostly fall off, but sometimes remain attached as before stated. Moreover, they are found even at the apex of the root, where one cannot find the root cap (fig. 7, A). Indeed, in the longitudinal section of the root apex, we can find no trace of the root cap and we find there a naked growing point

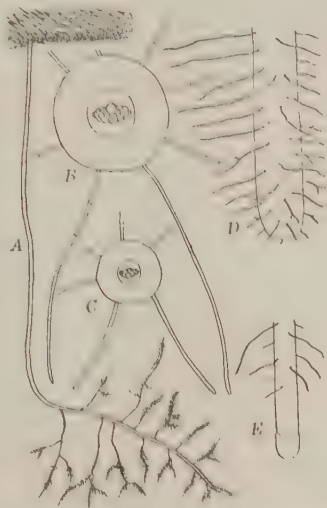


Fig. 6. *Oleandra Wallichii*; root system. A, an entire root system showing a long rhizophore and its branches. B, cross section of the rhizophore with multicellular hairs. C, cross section of its branch with unicellular hairs. D, apex of the rhizophore. E, apex of its branch with a root cap. A nat. size, B, C  $\times 35$ . D, E  $\times 20$

consisting of initial cells of equal size and form. From these characters, that is, the presence of multicellular hairs and greenish apex and the absence of a root cap, one cannot consider the roots as typical ones. In a cross section, however, they show the root structure, about 0.5 mm. in diameter. The epidermis consists of thin-wall cells. The cortex is relatively thin and may be distinguished into outer and inner parts, the outer consisting of thin-walled and pale brown cells, and the inner of thick-walled and dark brown cells. The pericycle consists of a layer of two cells thick, but the endodermis is not very distinct. The central bundle is of a diarch type, characteristic of the root, consisting of the tracheidal band with exarch protoxylems.

It is now to be observed whether the mode of departure of this organ from the stem is endogenously as the root, or exogenously as the stem.

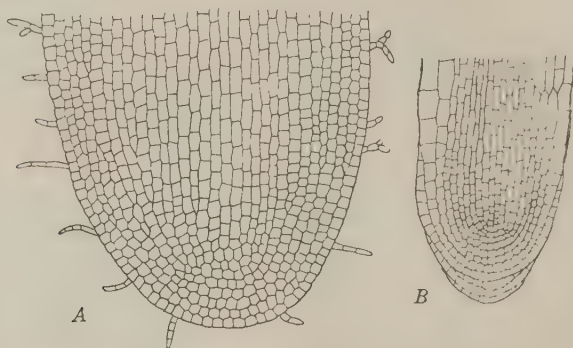


Fig. 7. *Oleandra Wallichii*; longitudinal sections of apex of the rhizophore (A) with multicellular hairs and its branch (B) with a root cap.  $\times 70$

If we make a section of the base of this organ, we see that the epidermis of the root continues directly to that of the stem, and that the cortex of both organs is also continuous; there is no trace of this organ penetrating the cortex of the stem. This explains its exogenous origin and shows that it is not a true root.

When this organ elongates itself, its basal part becomes darker and harder, that is, the cortical cells become thick-walled, and the hairs mostly peel off, but no further changes are recognizable.

The rootlets are much more slender than the mother root; they can elongate themselves to some extents and give off further branches. These rootlets or their branches are covered with fine brown hairs, which are always unicellular just like root hairs (fig. 6, C, E). Moreover, strangely enough, there is found a root cap on each apex of them, near which no



hairs are to be found (fig. 7, B). The structure of these rootlets in the cross section is just like the mother organ, but smaller and simpler. It is more important that, when the mother root gives them off, they penetrate the cortex of the former. All of these characters are characteristic of the root, and there is no doubt about considering them as true roots.

Then, how must we consider on the morphology of the root system which springs out of the rhizome? There is no doubt that it is not a true root judging from the anatomical characters above stated, while its branches and branchlets are true roots. A similar organ may be recognised in the genus *Selaginella*, in which such an organ since NÄGELI and LEITGE (1864) is called a root-carrier (Wurzelträger) or rhizophore and is considered to be a special organ, which stands between the stem and the root. In this genus such a root-like organ, which springs out of the stem exogenously, is provided with no root cap, its branches, on the contrary, springing out endogenously and being provided with root caps, just like the present species (BRUCHMANN 1905, GOEBEL 1930, OGURA 1938 a).

The rhizophoric nature of the root of this species, as well as *O. Cumingii* and *O. nodosa* was suggested by POIRAUT (1893), but no further details were given. The writer could confirm the suggestion he made.

In Pteridophytes the rhizophores are found besides *Selaginella* in *Lepidodendron*, in which large subterranean organ, the so-called *Stigmara*, is one of the rhizophores; the tubers of *Isoetes*, as well as *Pleuro-mcia* and *Nathorstiana* may be called as rhizophores. In Filicales, though on the stolons of *Nephrolepis* are questions regarding its rhizophoric nature, *Oleandra Wallichii* furnishes a sole representative of this category (literatures in OGURA, 1938 a).

### Anatomy and morphology of other species of *Oleandra*

According to CHRISTENSEN (1934), the genus *Oleandra* consists of 35 species more or less, possessing simple leaves with sori arranged along the midrib. The writer compared the dried materials of some species from Java and the Philippines kept in the Herbarium of the Tokyo Imperial University: i.e. *O. nerüiformis* CAV., *O. pistillaris* C. CHR., *O. benguetensis* COPEL., *O. Whitmeei* BAK. and *O. Cumingii* J. SM.

All these species when examined show strikingly similar features, both in external characters and in internal structure, the only difference among the species lying in the habitat of the stems. In some species they are more or less erect, and consequently are provided with leaves all round and more or less verticillately, while in some others they are creeping and



are provided with dorsal leaves just as *O. Wallichii*. The other differences among these species are only in form and size. These features will be briefly described, comparing them with those of *O. Wallichii*.

*Stem.* As just now described, there are two types in the form of the stem and the arrangement of leaves on it; in the first type the stem is creeping and the leaves are arranged on its dorsal side nearly in two rows, like as *O. Wallichii*, while in the second type, though the main parts creep the branches are more or less erect and the leaves are arranged on all sides radially. The latter type is represented by *O. neriiiformis* and *O. pistillaris*, in which some leaves are apt to arrange themselves in groups, so that a verticillate appearance results, but it is not truly verticillate and some leaves are arranged within a distance of a few mm.; moreover, an irregular arrangement is not uncommon. *O. benguetensis* belongs to this type, but it shows a slight tendency to be of the second type. Among the species examined, the first type is met with, besides in *O. Wallichii*, in *O. Cumingii* and *O. Whitmeci*. It may be noticed that the stem of the second type is stout, though not thick, and to some extent woody. In the second type, the leaves, which are verticillately arranged in a nodal region, are very variable in number; for example, in a specimen of *O. neriiiformis* are found within 5 mm. five leaves of a verticillate type, while in another stout one about fifteen leaves are closely arranged within a distance of 2 cm.

In all species the stem is densely covered with peltate scales, whose stalks are immersed somewhat within the grooves of the stem surface, so that the scales cover the stem very closely. Their shape is always lanceolate, and there are slight specific differences of size and form.

Owing to using dried materials the writer could not see the detailed internal structure but was able to see the arrangement of mechanical tissue and meristeles (fig. 8). The size of the stem in a cross section is nearly 3 mm. in diameter in *O. Whitmeci* and *O. Cumingii*, 4 mm. in *O. pistillaris* and 3–6 mm. in *O. neriiiformis* and *O. benguetensis*. The epidermis is always distinct. The cortex differs somewhat between the two types; in the first creeping type there is a hypodermis consisting of cells with slightly thick walls, while in the second erect type it consists of very thick-walled cells, which make the stem strong enough to keep in erect; besides the hypodermis a few layers around each meristele are also thick-walled. In all cases, dark brown cells, tannin cells, are found near the meristele.

The arrangement of meristeles in cross section is quite similar to that of *O. Wallichii*, because between the large meristeles are found one or two small meristeles (fig. 8). In *O. Whitmeci* and *O. Cumingii* are found five large meristeles more or less, while in the large stem of *O. neriiiformis*, *O. pistillaris* and *O. benguetensis* are ten or twelve large ones. The writer

did not trace the course of these meristeles in every species, but judging from the study of *O. neriiformis* and from the same mode of arrangement of large and small meristeles in other species, we can justly assume that their course might be in all species similar to that of *O. Wallichii*. The writer tried to trace their course in a small stem of *O. neriiformis*, in order to see whether the stelar system of this species with erect stem and radially arranged leaves is different from that with creeping stem and dorsally arranged leaves, and he was able, even in a dried material, to trace them. In the slender internode, about 3.5 mm. in diameter, there are in cross section six to eight large meristeles and one, rarely two, small ones between the two large ones. Their course is quite similar to *O. Wallichii*, that is, the large ones are dictyostelic, while the small ones diminish blindly (fig. 9). In the nodal region, where some leaves are closely arranged all round the stem, all of the small meristeles enter the petioles as the median leaf traces, while the lateral traces come from the large meristeles directly at the base of each petiole (fig. 9). The behaviour of the small as well as large meristele is, therefore, quite similar to that of *O. Wallichii*, the only difference being in the position of the leaf traces, which are situated all round the stem, instead of on the dorsal side as in *O. Wallichii*.

The structure of each meristele is similar to that of *O. Wallichii*. It is also the same as the latter species in that the base of the lateral branches is solenostelic.

*Leaf.* The leaves of all the species observed are similarly constructed. Each leaf has a short petiole with articulation and long simple lamina, measuring 20–30 cm. in length in *O. Cumingii* and *O. neriiformis*, and 30–50 cm. in *O. Whitmeei*, *O. pistillaris* and *O. benguetensis*. In the lamina, lateral veins from the midrib are also similarly constructed; they are straight or branching once or twice, running parallel to each other. In *O. Whitmeei*, *O. neriiformis* and *O. benguetensis*, fine scales and hairs are found on the petiole and midrib, hairs also on the lamina, while in *O. pistillaris* and *O. Cumingii* the leaves are mostly bare or slightly hairy.

In cross section of the petiole one sees a hypodermal layer and three or four meristeles, the two adaxial ones being the larger. These features

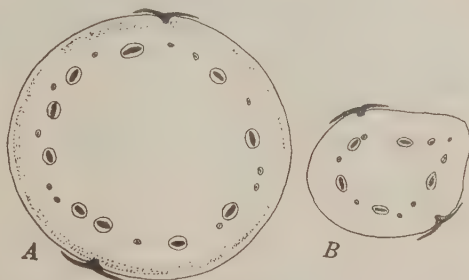


Fig. 8. *Oleandra neriiformis* (A) and *O. Whitmeei* (B); cross sections of the stems, showing peltate scales and the arrangement of large and small meristeles. Dotted, hypodermis.  $\times 7$

are also similar to *O. Wallichii* and the stellar system is of the *Polypodium*-type.

The lamina is thin and membranaceous, except in *O. neriiformis* and *O. pistillaris*, in which it is somewhat coriaceous and opaque. The mesophyll consists of several layers of undifferentiated roundish cells; the only exception is found in *O. pistillaris*, for in this species under the upper epidermis is found a layer of large cells destitute of contents. This layer represents perhaps a water tissue, which may be found in some ferns, such as *Polypodium* and *Cyclophorus*.

*Sorus.* The sorus is situated on the undivided vein near its basal part. It is covered by a small reniform indusium, under which may be

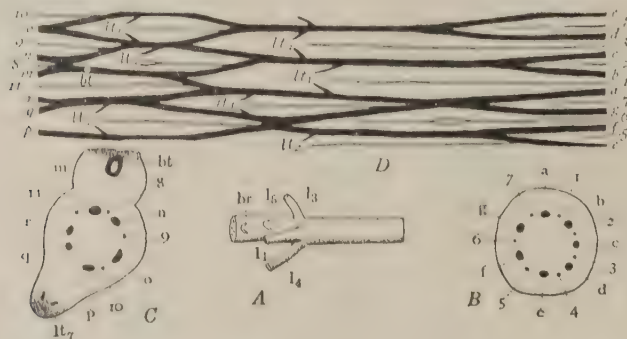


Fig. 9. *Oleandra neriiformis*; diagram showing the construction of the stellar system of a part of the stem shown in A. B, C, cross sections of the stem at its right (lower) and left (upper) ends. D, diagram of stellar system developed in a plane, showing the course of large and small meristeles.  $l_1$ - $l_7$ , leaves ( $l_5$  abortive). br, lateral branch. a-g, 1-7, large and small meristeles at the right end. m-r, 8-11, the same at the left end.  $lt_1$ - $lt_7$ , leaf traces for the leaves  $l_1$ - $l_7$ . bt, branch trace for the lateral branch br. A nat. size, B, C  $\times 35$

found sporangia in different stages of development. The indusium is always thin and entire; in *O. Cumingii* and *O. benguetensis* hairs are seen on its margin. In *O. Whitmeei* it is circular, because of the basal lobes on both sides overlapping each other. The sporangium has a long stalk, which is found in all species with short paraphyses. The spores are reniform, about 0.04 mm. in large diameter, and ornamented by a thin irregular cover, which is somewhat finely dentate in *O. Whitmeei*.

*Root.* The root system is very incompletely preserved in the dried specimens. This system, similar to *O. Wallichii*, is found in *O. Whitmeei* and *O. benguetensis*, in which long unbranched parts and those with lateral branches are to be seen. In *O. Cumingii* some roots are short and

much branched, and in *O. neriiformis* and *O. pistillaris* we see no roots on the greater part of the stem. In the latter form, they are perhaps lacking in the erect part of the stem.

These roots are all thin, and we could not see their detailed structure in the dried specimens; the presence or absence of the root cap or the mode of departure is never observable. It is, however, certain that the hairs on the main roots are multicellular, while those on their branchlets are unicellular. Though this is the only evidence, there is no doubt that the root-like organ has a rhizophoric nature. POIRAULT (1893) suggested the roots of *O. Cumingii* and *O. nodosa* to be of a rhizophoric nature. The explanation of the root system of *O. Wallichii* is, therefore, to be applied to all species of the genus.

### Affinities of the genus *Oleandra*

It is true that the species of *Oleandra* mentioned above have very similar characteristics in external features and in internal structure, and there is no doubt that they, so far as the species examined are concerned, belong to a natural group, *Oleandra*. The genus *Oleandra* was established in 1799 by CAVANILLES with *O. neriiformis* as the type species. The species belonging to this genus are tropical ferns, and some of them were formerly included among *Aspidium* or special genera, *Neuropteris* or *Ophiopteris*. In the Index of CHRISTENSEN (1906) ten species are enumerated, and later (III supplement, 1934) as many as thirty five species. It is not certain whether these species are provided with morphological and anatomical characters such as described above, though they show the external characters of *Oleandra*-type. *O. Wernerii* ROSENS. from New Guinea is somewhat different, as it shows dimorphic leaves.

This genus is characterized by 1) a creeping rhizome covered with peltate scales, 2) an articulate petiole, 3) a simple undivided lamina, 4) free parallel veins, 5) a single sorus on the base of a vein, 6) a reniform indusium opened outwards and 7) reniform spores. These are truly the important characteristics of the genus, by which it may be distinguished from other genera. Based on the characteristics above mentioned, this genus was formerly included in general in the tribe Aspidieae of the Polypodiaceae, as e.g. by HOOKER (1862), HOOKER and BAKER (1874) or CHRIST (1897). HOOKER and BAKER placed this genus near *Aspidium* (in the wide sense), *Nephrodium*, *Nephrolepis* or *Fadyenia*; CHRIST, near *Aspidium*, *Phegopteris*, *Hypolepis*, *Pleosorus*, *Cystopteris*, *Woodsia* etc. POIRAULT (1893) compared the roots of this genus with the rhizophores of *Selaginella*. A little later DIELS (1902) took out this genus from Aspidieae and Davallieae and established a new tribe Oleandreae, represented by a single genus *Oleandra*, which stood between



both tribes, Aspidieae and Davallieae. This classification was adopted by CHRISTENSEN (1906). *Nephrolepis*, one of the ferns, which is generally believed to be in close relationship with *Oleandra*, is included in Aspidieae by HOOKER and BAKER, but in Davallieae by CHRIST, DIELS and CHRISTENSEN. BOWER (1928), who discussed the affinities of ferns from the various points of view, could not reach a conclusion regarding the affinity of this genus, and put it near *Davallia*-like ferns as a fern of unknown affinity. ARBELÁEZ (1928), who discussed Davalliaceae, did not touch on this genus.

There are no other important contributions on the morphology and affinities of the genus *Oleandra*. The writer has therefore to consider the affinity of this genus, based not only on characteristics already well known but also on the anatomical and morphological features now observed.

*Stem.* Though *O. Wallichii*, *O. Cumingii* and *O. Whitmeei* show the distinct dorsiventrality of the rhizome, it is not at all a characteristic of this genus, for in *O. neriiiformis*, *O. pistillaris* and *O. benguetensis* some parts of the stem are more or less erect and the leaves are arranged all round the stem. METTENIUS (1863-64) divided *Oleandra*-species from the habitat of the stem into three sections; section 1. with creeping rhizome and dorsal leaves (*O. nodosa*), section 3. with leaves all round the erect stem (*O. neriiiformis*), and section 2. of a type intermediate between the two (*O. musaeifolia*). It is, however, very difficult in such epiphytic ferns to determine whether the stem is creeping or erect. It is said that in *O. neriiiformis* the main part of the stem is creeping and its branches are suberect. It may be generally accepted that the radial form of the stem is primitive and the dorsiventral form is derivative. Though in the first type the dorsiventral structure becomes more or less stable, in the second type it is not so and the radial type is still to be seen. In the writer's opinion, the second type with the radial form is more primitive than the first with a dorsiventral structure.

Concerning the scales on the stem, the peltate form is one of the characteristics of the species of *Oleandra* observed. Peltate scales are rather rarely found in ferns, among Davallieae and Aspidieae in such as *Davallia*, *Humata* and *Nephrolepis*. It may be however noticed that the rhizome in some species of *Davallia*, e.g. *D. divaricata* and *D. decurrens* is provided with cordate scales (ARBELÁEZ 1928), and also that in *Oleandra*, though the stem scales are peltate, those of the leaf are cordate. On the other hand, the presence of the stalk of the scale, which immerses in the groove of the stem surface, is rather prominent in all the species observed. The similar feature of the stalk is also found among Aspidieae and Davallieae in *Davallia* and *Humata*. This fact makes the writer regard the present genus as akin to *Davallia* or *Humata* rather than to *Nephrolepis*, whose scale stalk does not immerse into the stem.



The presence of large and small meristeles in the stem is also to be found in *Davallia* and *Humata*, in which however the dorsiventral arrangement is clear and some small meristeles are arranged in two lateral arcs. Comparing the stelar system of *Oleandra* with that of *Davallia* or *Humata*, we have called it a kind of perforated dictyostele, but we cannot find a close relationship among them, because in *Oleandra* the dorsiventrality of the stelar system, which is very distinct in *Davallia* and *Humata*, is not distinct, and some of the small meristeles diminish blindly. Most of the species of *Leptochilus*, which is usually included in Aspidieae, show in a cross section of the stem a very similar stelar system to that of *Davallia*, because it consists of dorsal and ventral large meristeles and lateral series of small ones, the latter are, however, the leaf traces in normal sense, so that the stelar system is only represented by large ones, which are dictyostelic (BOWER 1917). The diminishing of the meristele in their way as in *Oleandra* is very rare phenomena in ferns, even when it occurs it is only in an abnormal case. The regular case of such a diminishing is met with in some medullary meristeles of *Diplazium esculentum* (OGURA 1927 b) and some Cyatheaceae (OGURA 1927 a), but it occurs in descending course. The stelar system of *Oleandra* is therefore very characteristic.

Among the species, except *Davallia* and *Humata*, which are usually classified among Davalliaceae, the stelar system of the stem is mostly solenostelic or dictyostelic; *Nephrolepis*, *Cystopteris*, *Woodsia*, *Pleosorus*, which are believed to stand near *Oleandra* have dictyosteles, and *Hypolepis*, *Leptolepis* or *Dipteris* have solenosteles.

Summarizing these facts, the stelar system of *Oleandra* is so completely specialized that we cannot find any allied form in other ferns. If we want to point out allied, but not homologous, steles we can do so with *Davallia* or *Humata*, while *Nephrolepis* is of a rather different type.

*Leaf.* Now we turn to the leaf. One of the characteristics of the leaf in *Oleandra* is the presence of the stelar system of the *Polypodium*-type in the petiole and midrib. This type consists of two large adaxial meristeles and a few abaxial small ones, which upwards are reduced to two large ones, and then to one. A similar type, which is found among Polypodiaceae, is the *Aspidium*-type. Both types are distinguished by the form of the tracheidal mass in the large meristeles; in the *Polypodium*-type it is arc-shaped, while in the *Aspidium*-type it is the so-called hippocampus-shaped, that is, an arc form with hooks on both ends. Consequently, when the two meristeles fuse with each other at the middle part of the midrib, they become in the *Aspidium*-type V-shaped, and, in the *Polypodium*-type, x-shaped. These two types were hitherto thought to be mixed together, but they have to be distinguished. The number of small meristeles has no important significance; in general, there are many

in the larger petioles, but in the smaller ones they are sometimes altogether lacking. In the latter case, that is, the case of only two large meristele, which is also found in the midrib of the species with *Polypodium*- or *Aspidium*-type, two types also can be distinguished by the tracheidal mass within the meristele, namely the *Asplenium*-type and the *Onoclea*-type, the former being of the *Polypodium*-type and the latter of *Aspidium*-type. The conclusion of this is that, the *Polypodium*- and *Asplenium*-types on the one hand, and the *Aspidium*- and *Onoclea*-types on the other hand, are respectively in close affinity. *Oleandra* belongs to the *Polypodium*-*Asplenium*-series of the stelar type. Most of the Davallieae belong to this type, while most of the Aspidieae belong to the *Aspidium*-*Onoclea*-series of the stelar type (OGURA 1938 b).

The simple lanceolate form of the leaf is one of the characteristics of all species of *Oleandra*, but more important is it that it is provided with parallel veins. Each vein is straight or bifurcates and shows the same form and size, which makes the lamina form simple. If there are repeated bifurcations of the veins, there may occur a differentiation of their size or length; consequently a complex form of lamina occurs. The simple form of the leaf depends, therefore, upon the uniformity of the lateral veins, such as may be found in a pinna or pinnule of other ferns. Free veins are not rare among ferns, but it is rather rare that the veins run to such a length without fusing with one another, as in *Oleandra*, which is in this respect solitary among the Aspidieae and Davallieae, though we see some similar veins among other tribes of Polypodiaceae, such as *Phyllitis*, *Camptosorus* or *Asplenium nidus*, whose petiolar stele is of the *Asplenium*-type, although the soral form is quite different.

*Sorus*. The position of the solitary sorus on the free vein is also characteristic in this genus, because most of the solitary sori in ferns are situated at the end of the free vein; even when they are on the veins they are situated mostly near the end. The position in this genus is quite the reverse, as they are situated very near the base of each vein; and this is more exaggerated by the length of the vein. Most of the Davallieae and Aspidieae with free veins show the sori situated at the end of the veins, and even in the dorsal sori they are situated near the end. In this respect this genus stands in a solitary position.

The reniform indusium is also one of the characteristics of this genus, but such a form is also met with among Davallieae and Aspidieae in *Nephrolepis*, *Nephrodium* or *Fadyenia*. That BAKER and HOOKER placed *Oleandra* near these genera seems to be on the strength of this characteristic.

In the matter of sporangia and spores this genus has no important characteristics. The presence of paraphyses and reniform spores is universally found among Polypodiaceae. The structure of sporangia is of the Polypodiaceae type and their development is of the mixed type.

*Root.* The morphological nature of the root system is, as was fully shown, very important and is one of the most important characteristics of *Oleandra*. Among ferns there is no one which is provided with such a rhizophoric system as this genus. It is not evident, why such an organ develops only in this genus; it may be said, however, that such is the result of an adaptation for epiphytic life. The writer can anticipate that there may be more species with such an organ, if we carefully examine further the other epiphytic ferns.

Summarizing the above criterion, the genus *Oleandra* seems to stand in a solitary position and to represent an isolated natural group. Above all the small meristeles turning to leaf traces, but sometimes diminishing blindly, as well as the root system provided with a rhizophoric character, are the characteristics which cannot be found among other Polypodiaceae. Other characters, such as the form of leaf, venation, position of sori, form of indusium and sporangium are secondarily important, but even in such characteristics we have no ferns which coincide with this genus. *Nephrolepis*, which is generally believed to be close to *Oleandra*, is related to this genus in possessing peltate scales, a *Polypodium*-type of petiolar stele, reniform indusium and spores, but differs in many other points. On the other hand, *Davallia* or *Humata* shows many similar points with this genus in possessing peltate scales with immersed stalks, small meristeles turning to leaf traces, an articulate petiole, a *Polypodium*-type of petiolar stele, but they have a special stelar system, non-parallel veins, marginal sori and bivalved indusia.

It must be remembered that in ferns such a case is rather common; if one compares the characteristics of one fern with others, he finds similarity in venation with A plant, in stelar system with B plant, in sorus with C plant, etc., and different types of leaves or veins are sometimes met with in very closely related species. In these cases the characters of sori or sporangia are used as the standard of the criterion as being of primary importance. In the case of *Oleandra*, a creeping rhizome covered with peltate scales, whose stalks immerse in the rhizome, is alike with *Davallia*, *Humata* or *Cyclophorus*, an articulate petiole with *Davallia*, *Humata*, *Polypodium*, *Cyclophorus* and some others, a simple leaf with parallel veins with *Asplenium*, *Phyllitis* or *Camptosorus*, the *Polypodium*-type of petiolar stele with *Davallia*, *Humata*, *Nephrolepis*, *Polypodium* or *Cyclophorus*, a reniform indusium with *Nephrolepis*, *Fadyenia* or *Dryopteris* (*Nephrodium*). The genus *Oleandra* may therefore be an "synthetic genus".

That this genus is considered generally to be close to *Nephrolepis* or other genera of Davallieae or Aspidieae is mainly based on the soral characters, notwithstanding that in the characters of vegetative organs

this is not always the same with the latter plants. Accordingly, when we consider the characteristics of *Oleandra* as a whole, reproductive as well as vegetative, it may be natural to take out this genus from the tribe Davalliace or Aspidieae and to put it into an independent group. The isolation of *Oleandra* as a tribe Oleandreae, made by DIELS, is in this respect rather reasonable, and this is justified still further, when we consider the stelar character and rhizophoric nature. On the other hand, it is not unsuitable attempt to raise up *Oleandra* as the representative of an independent family Oleandraceae. The soral and sporangial characters are, however, of the Polypodiaceous type, so that if we consider such reproductive organ as of primary importance, it may be still included among Polypodiaceae. It is most reasonable in the classification of ferns to consider the characters of the vegetative organs as well.

### Summary

1. *Oleandra Wallichii* from Formosa was studied anatomically and morphologically, and dried specimens of *O. neriiformis*, *O. pistillaris*, *O. benguetensis*, *O. Cumingii* and *O. Whitmeei* were also studied.

2. The stem of *O. Wallichii*, *O. Cumingii* and *O. Whitmeei* is as a whole creeping provided with dorsal leaves and ventral roots, while that of *O. neriiformis*, *O. pistillaris* and *O. benguetensis* is more or less erect, roots and leaves arising all around it.

3. The stem is covered closely with peltate scales, whose stalks immerse in the grooves on the stem surface.

4. The stele of the stem is of a kind of perforated dictyostele. It consists of large and small meristeles arranged in a circle in cross section. The large meristeles are constructed in dictyostelic manner, while the small ones enter the petioles as their median leaf traces, the lateral traces coming directly from the large ones, but the small ones sometimes diminishing blindly in their course.

5. The stele of articulate petiole and midrib is of a *Polypodium*-type; it consists of two large adaxial meristeles and one or two small abaxial ones.

6. The lateral veins of the leaf are straight or bifurcate, running altogether in a parallel manner. The solitary sorus is situated on the basal part of the vein, covered with reniform indusium.

7. The sporangia, situated on a receptacle, are of a mixed type. Each sporangium is provided with a few paraphyses, and is Polypodiacean in structure. The spores are reniform with transparent covers.

8. The root-like organ, which springs out of the stem exogenously, is provided with multicellular hairs but with no root cap, and gives off



branches endogenously, which are provided with unicellular hairs and root caps; both have a diarch bundle. Though the branches are in their nature roots, the former is not a typical root and must be a rhizophore, just like that of *Selaginella*.

9. Summarizing the characteristics studied, the genus *Oleandra* stands far remote from other ferns, and may be in an isolated phyletic position. The establishment of a special tribe Oleandreae or a family Oleandraceae for this genus seems therefore to be reasonable.

The writer expresses his sincere thanks to the Japan Society for the Promotion of Scientific Research, by whose help the expense of the present work has been partly defrayed. Thanks are also due to Dr. F. SEKI and Mr. K. NAGAYAMA of the Government of Formosa as well as Professor S. HIBINO and Mr. T. HOSOKAWA of the Taihoku Imperial University.

January, 1938

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# On the change of flora of Japan since the Upper Pliocene and the floral composition at the present

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With plates III-IV and 18 text-figures

(Received January 29, 1938)

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## I. Introduction

The floristic composition of the northern hemisphere before the middle Tertiary was rather simple and the distribution of species was wide. Since the late Tertiary, it got, however, more and more complex on account of the enormous folding of the Himalayan and Alpine Ranges, and the glacial extension in Europe and America. In Japan, though there might have taken place various orographical and climatic changes

during the ages, their features are rather obscure, because little were known of the veritable fossil data to discuss the climatic or topographical changes.

The fauna investigation of these ages are concerned chiefly of shell remains or mammals. The habitats of the former are confined in water having no relation to the aridness, though the latter show some adaptability to the climatic changes. As to the plant remains, the collections are rather scanty and incomplete. But as the plants can grow under various climatic and edaphic conditions, their remains show us clearly the ecological features of these beds, so far as the collections are sufficiently identified. Not only the climatic and topographical characters, but also the orographical changes during the ages could be deduced from them.

In this paper the floristic changes since the Upper Pliocene, and the origin and composition of the recent flora based upon the plant remains, with special reference to the climatic and orographical changes, are discussed.

The method of collection and preservation is the same as before (13).

I wish to express here my sincere thanks to Prof. K. KORIBA under whose direction and courtesy this study was undertaken. Further more I wish to express my thanks to Prof. J. MAKIYAMA who gave me valuable suggestions concerning geological questions and Mr. N. NAORA who kindly gave me material from Tokyo and helped the collection at this place. Thanks are due also to Dr. J. OHWI, Dr. R. TOYAMA who kindly identified the plant remains.

## II. The localities of the present collections

The localities of plant remains are shown in the Table 1 and fig. 1.

TABLE I

	Prefecture	North latitude	East longitude	Altitude from sea-level
<i>Juglans cinerea</i> bed	Iwate	39°25'30"	141°7'30"	70 m
Plant bed near Katada	Siga	35°6'40"	135°53'	100 m
Lignite bed of Simokurada	Kanagawa	35°22'30"	139°33"	60 m
Conifer bed and neolithic bed of Ekoda	Tokyo	35°43'	139°38'30"	31 m
Peat bed of Azuti	Siga	35°9'	136°7'30"	85 m

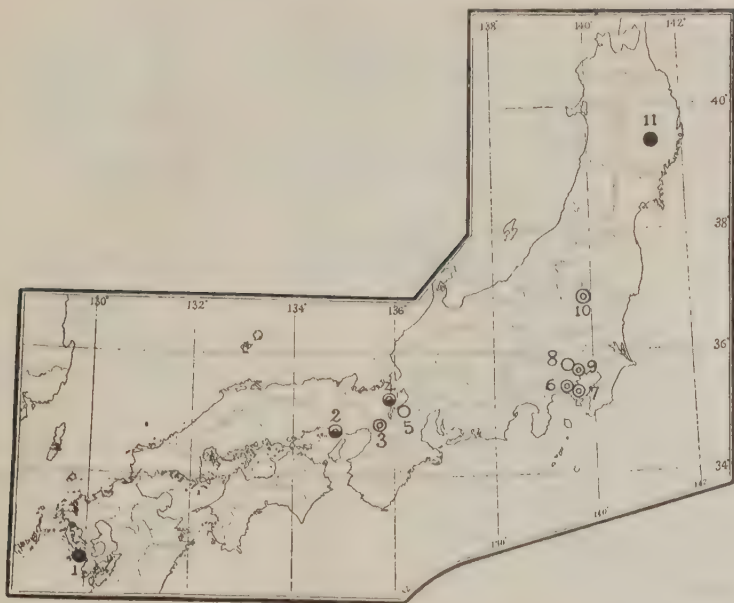


Fig. 1. Map showing the distribution of plant beds discussed in this paper

1. The plant bed of Mogi, Nagasaki Prefecture
2. The plant bed Akasi, Hyogo Prefecture
3. The plant bed of Yamasiro, Kyoto Prefecture
4. The plant bed near Katada, Siga Prefecture
5. The plant bed of Azuti, Siga Prefecture
6. The lignite bed of Simokurada, Kanagawa Prefecture
7. The plant bed of Yokohama, Kanagawa Prefecture
8. The conifer bed of Ekoda, Tokyo Prefecture
9. The neolithic bed of Ekoda, Tokyo Prefecture
10. The plant bed of Siobara, Totigi Prefecture
11. The *Juglans cinerea* bed of Hanamaki, Iwate Prefecture

### III. The description of the plant remains

#### A THE *Juglans cinerea* BED OF HANAMAKI

##### a General

Nut remains of *Juglans cinerea* at the floor of the River Kitakami of Kofunato near Hanamaki were first studied by HAYASAKA(3), then by SAITO(24), and the age was determined to be the Upper Pliocene. The remains of other plants were noted by the latter, though without detailed identification. The writer collected here the following plant remains in the bed.

b *Plant remains: Table 2; Fig. 2 A-M, Pl. IV B. L. N*

## Explanation of abbreviations

Occurrence: A Abundant; C Common; R Rare.

## Parts of remains:

F Fruit; S Seed; L Leaf; Sh Shoot; Sp Spine; Ls Spiny leaf; B Branch;  
T Trunk; Rh Rhizome.

## Distribution of the species or their allies at the present.

A North America.

C Central China.

F Formosa or Southern China.

H Central part of Japan (with the altitude at the present).

I Iran to Mediterranean.

J Southern part of Japan.

O China and Japan.

Y Northern half of Japan or Yezo.

Gothic type: species extinct or not found in wild state in Japan.

TABLE II

	Occurrence	Remains	Distribution	Characters of identification
Juglandaceae				
1 <i>Juglans cinerea</i> L. (Pl. IV N)	A	F	A	Large nut with deep sculpture
Betulaceae				
2 <i>Alnus japonica</i> S. et Z. (Fig. 2 J)	C	F	J-Y	Size and shape of scales
Magnoliaceae				
3 <i>Magnolia Kobus</i> DC. (Fig. 2 H)	R	S	J-Y	Cordate seed without dorsal striation
Rosaceae				
4 <i>Prunus Haussknechti</i> SCH. (Pl. IV B, Fig. 2 B)	A	F.Sp	I	Shape of seed and remains of husk
5 <i>Pyrus cf. Wilhelmi</i> SCH. (Pl. IV L, Fig. D-E)	C	F.Sp	I	Hilm distinct, each cell with two seeds, remains of carpel wall
6 <i>Rosa</i> sp. (Fig. 2 G)	R	Sp	J-Y	Shape of prickles remains
Leguminosae				
7 <i>Gleditschia japonica</i> MIQ. (Fig. 2 K)	R	Sh	J-H	Large thorn branches
Aceraceae				
8 <i>Acer cf. Nordenskiöldi</i> NATH. (Fig. 2 I)	R	F		Peculiar large fruit remains
Rhamnaceae				
9 <i>Paliurus nipponicus</i> MIKI (Fig. 2 A)	C	F.B.Sp	I	Fruit with entire wing
Vitaceae				
10 <i>Vitis</i> sp. (Fig. 2 M)	R		O	
Styracaceae				
11 <i>Styrax obassia</i> S. et Z. (Fig. 2 L)	C		O	Large seed with basal hilm and a few striations





Fig. 2. Plant remains in the *Juglans cinerea* bed of Hanamaki.

- A Remains of *Paliurus nipponicus* MIKI.  $\times 1$ : a-b fruits, c twig, d prick'les.  
 B Remains of *Prunus Haussknechti* SCH.  $\times 1$ : a with exocarp.  
 C Thorn remains of Rosaceae.  $\times 1$ .  
 D-F Remains of *Pyrus* cf. *Wilhelmi* SCH.  $\times 1$ : D fruits, partly fragmental, E seeds from fruit remains, F young fruits (?).  
 G Prickle remains of *Rosa* sp.  $\times 1$ .  
 H Seed remain of *Magnolia Kobus* DC.  $\times 1$ .  
 I Seed remains of *Acer* cf. *Nordenskiöldi* NATH.  $\times 1$ .  
 J Remains of *Alnus japonica* S. et Z.: a scales of cone.  $\times 2$ , b  $\times 1$ .  
 K Thorn remains of *Gleditschia japonica* MIQ.  $\times 1$  b (?).  
 L Seed remains of *Styrax obassia* S. et Z.  $\times 1$ .  
 M Seed remains *Vitis* sp.  $\times 2$ .

### c Floral composition and its character.

Among the 11 species just enumerated, 5 species (45%) with prickles or thorns and 5 species (45%) are completely extinct or at least so in Japan today.

### d Age and climate

Geological age of this bed is Upper Pliocene as stated by HAYASAKA and SAITO. Here are found more extinct species than the beds of the Pleistocene. The climate may be regarded as arid, because half the number of the species have prickles or thorns, and their allies are now found in arid region in the continent, as *Paliurus nipponicus* MIKI, *Prunus Hausskneckti* SCH. and *Pyrus cf. Wilhelmi* SCH.

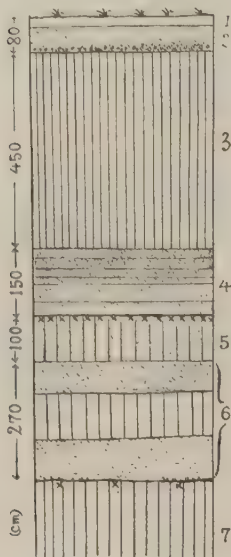


Fig. 3. Profile of the Kitamuki-cutting, at Ogi-mura near Katada.

1. Soil.
2. Sands with gravels in lower part.
3. Deep gray mud.
4. Sand layer with ferruginous band.
5. Sandy clay with plant remains in upper part.
6. Alternating sands and clay.
7. Bluish clay.

× × × Indicates the plant remains.

## B THE PLANT BED NEAR KATADA

### a General

The bed belongs to Kobiwako Series, which forms hilly upland around Lake Biwa, where some lacustrine mollusca, *Trapa* and *Stegodon orientalis* etc. were recorded (16). The remains were yielded from places at the west side of the lake: Simoryuge<sup>(1)</sup> in Ikadati-mura, Oono in Mano-mura and Kitamuki in Ogi-mura near Katada, of which the latter was the richest. The fossil bed is between sand and clay layers as shown in fig. 3. The basement clay contains vivanite particles, with the remains of *Paliurus nipponicus*.

(1) The writer is indebted to Mr. T. HASIMOTO of the Womans Normal School of Siga for this material.

b *Plant remains*: Table 3; Fig. 4-5, Fig. 14 Fa, La, Pl. IV J

TABLE III

	Occurrence	Remains	Distribution	Characters of identification
Filicinae				
Polypodiaceae				
1 <i>Pteridium aquilinum</i> KUHN. (Fig. 4 E)	R	L	O	Frond with <i>neuropteris</i> type nervation
Coniferae				
Taxaceae				
2 <i>Cephalotaxus drupacea</i> S. et Z. (Fig. 4 A-B)	R	S	O	Shape of seed and its epidermal cell shape
Pinaceae				
3 <i>Abies firma</i> S. et Z. (Fig. 4. D)	A	L.S.F	H(500- 1000m)	Large long bract and leaf
4 <i>Chamaecyparis pisifera</i> S. et Z. (Fig. 4 G)	A	F.Sh	H	Cone small and leaf acute
5 <i>Cyrtomeria japonica</i> DON (Fig. 4. C)	R	Sh	J	Twig without whorled ar- rangement of leaves
6 <i>Pinus Thunbergii</i> PARL. (Fig. 4 H-J)	C	L.Sh.F	H	Twig with marked decur- rent bases of leaf branches
7 <i>Tsuga Sieboldii</i> CARR. (Fig. 4 F)	C	L.Sh.F	J-H(500- 1000m)	Twisted stalked leaf and small ciliated bract
Dicotyledoneae				
Salicaceae				
8 <i>Salix</i> cf. <i>lasioogyne</i> SEEM. (Fig. 4 M)	C	L	H	Acute leaf with fine serra- tion
Betulaceae				
9 <i>Alnus japonica</i> S. et Z. (Fig. 4 K)	C	F	J-Y	Remains of cone-like catkin
Fagaceae				
10 <i>Fagus Hayatae</i> PALIB. Fg. 4 Q-S)	A	F.S.L	F	Serrated leaf and short stalk- ed cupule, covered with prickles
11 <i>Quercus gilva</i> BL. (Fig. 4 N-P)	C	F.S.L	O	Long style, ring marked cupule and tufted hair remains on the underside of leaves
Ulmaceae				
12 <i>Zelkova Ungerii</i> KOVATS. (Fig. 4 L)	C	F.L	I	Crenate margin of leaf
Berberidaceae				
13 <i>Berberis longispinus</i> MIKI (Fig. 5 B)	R	Ls	C	Leaf with one large prickles
Menispermaceae				
14 <i>Cocculus trilobus</i> DC. (Fig. 14 Fa)	R	S	O	Seed grub-shaped
Lauraceae				
15 <i>Neolitsea aciculata</i> KOIDZ. (Fig. 5 L)	C	L	O(?)	Nervation and scar of hairs on the stalk

TABLE III (Continued)

	Occurrence	Remains	Distribution	Characters of identification
Hamamelidaceae				
16* <i>Corylopsis epigyna</i> MIKI n. sp. (Pl. IV J, Fig. 5 C-D)	C	S.F	O(?)	Capsule sessile on the spike, receptacle only at base
Rosaceae				
17 <i>Rosa akashiensis</i> MIKI (Fig. 5 A)	R	Sh	O(?)	Opposite hooked prickles
Leguminosae				
18 <i>Gleditschia japonica</i> MIQ. (Fig. 5 F)	C	Sh	O	Large thorn branches
19 <i>Wistaria floribunda</i> DC. (Fig. 5 G)	R	Sh.L	H	Petiole with pluvinus, con- stricted scales of winter bud
Euphorbiaceae				
20 <i>Sapium sebiferum</i> ROXB. var. <i>pleistoceaca</i> MIKI. (Fig. 5 I)	R(C)	S	C-F	Shape and size of black lus- tred seed
Aquifoliaceae				
21 <i>Ilex cornuta</i> LDL. et PAXT. (Fig. 5 J)	C	L	C	Short stalked leaf with rectangular serration
Aceraceae				
22 <i>Acer crataegifolium</i> S. et Z. (Fig. 5 N)	R	S	J-H	Long seed-like nutlet
Hippocastanaceae				
23 <i>Aesculus</i> n. sp. (?) (Fig. 5 M)	C	F.L	O(?)	Differs from the recent one by the size of epidermal cells of testa being one half smaller
Rhamnaceae				
24 <i>Berchemia racemosa</i> S. et Z. (Fig. 14 La)	R	F	O	Compressed oblong fruit
25 <i>Paliurus nipponicus</i> MIKI. (Fig. 5 E)	R(C)	F.Sp.Sh	I	Entire wing of fruit
Vitaceae				
26 <i>Vitis</i> sp. (Fig. 5 O)	R	S	O	
Theaceae				
27 <i>Camellia japonica</i> L. (Fig. 5 K)	C	F.S	O	Loculicidal pericarp and peculiar shape and size of seed
Elaeagnaceae				
28 <i>Elaeagnus</i> sp. (Fig. 5 Q)	R	L	O	Remains of stellate hairs
Hydrocaryaceae				
29 <i>Trapa macropoda</i> MIKI. (Fig. 5 H)	R(C)	F		Large four horned fruit with long axial part under horns
Styracaceae				
30 <i>Styrax japonicum</i> S. et Z. (Fig. 5 P)	C	S	J-Y	Small elliptical seed with basal hilm and a few stri- ations
Monocotyledoneae				
Gramineae				
31 <i>Phragmites communis</i> TRIN.	C	H.R	O	



Fig. 4. Plant remains in the plant bed near Katada.

- A-B Seed remains of *Cephalotaxus drupacea* S. et Z.: A  $\times 1$ , B surface view of seed epidermis  $\times 333$ .  
 C Twig remains of *Cryptomeria japonica* DON  $\times 1$ .  
 D Remains of *Abies firma* S. et Z.  $\times 1$ : a scales of cone, b leaves.  
 E Frond remains of *Pteridium aquilinum* KUHN.: a  $\times 1$ , b enlarged nervation  $\times 10$ .  
 F Remains of *Tsuga Sieboldii* CARR.  $\times 1$ : a cone, b scale, c leaves, d twig with leaves.  
 G Remains of *Chamaecyparis pisifera* S. et Z.  $\times 1$ : a twigs, b cones.  
 H-J Remains of *Pinus Thunbergii* PARL.  $\times 1$ : H leaves, I cortex of twig, J cones.  
 K Remains of *Alnus japonica* S. et Z.  $\times 2$ : a scales, b seed.  
 L Remains of *Zelkova Ungerii* KOVATS.: a leaves  $\times 1$ , b fruit  $\times 4$ .  
 M Leaf remains of *Salix* cf. *lasiogyne* SEEM.  $\times 1$ .  
 N-P Remains of *Quercus gilva* BL.: N leaves  $\times 1$ , O hair remains from underside  $\times 100$ , P fruits  $\times 1$ .  
 Q-S Remains of *Fagus Hayatae* PALIB.  $\times 1$ : Q leaves, R seeds, S cupule.



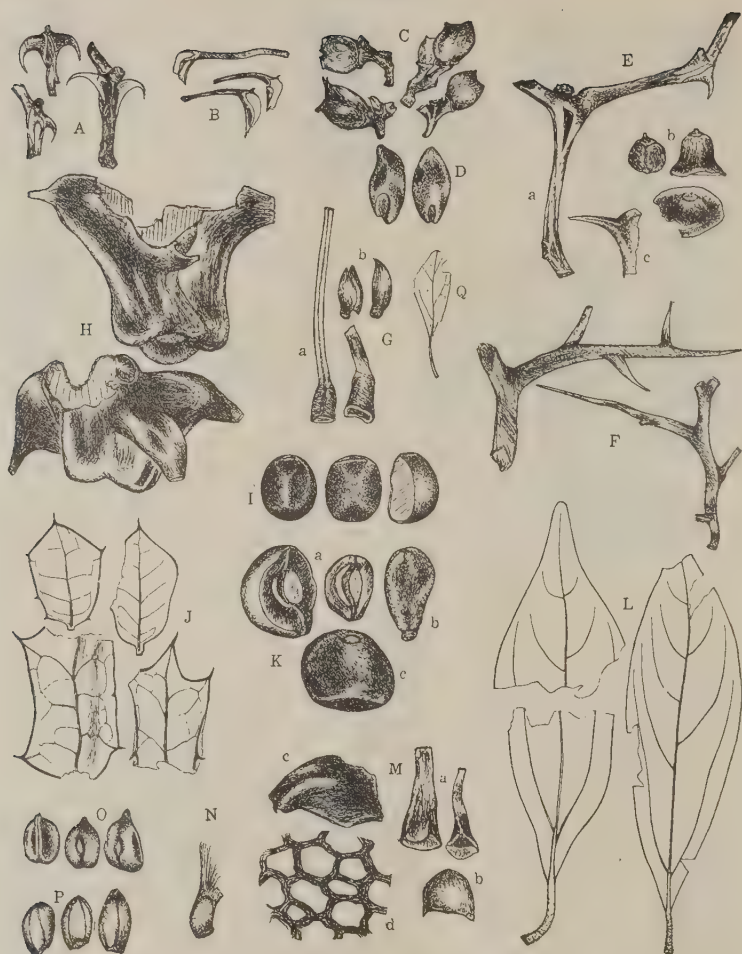


Fig. 5. Plant remains in the plant bed near Katada.

- A Twig remains of *Rosa akashiensis* MIKI  $\times 1$ .  
 B Prickly leaf remains of *Berberis longispinus* MIKI  $\times 1$ .  
 C-D Remains of *Corylopsis epigyna* MIKI n. sp.: C  $\times 1$ , D seeds  $\times 2$ .  
 E Remains of *Paliurus nipponicus* MIKI  $\times 1$ : a twig, b fruits, c prickle.  
 F Remains of branched spine of *Gleditschia japonica* MIQ.  $\times 2/3$ .  
 G Remains of *Wistaria floribunda* DC.  $\times 1$ : a leaf stalk, b winter buds.  
 H Fruit remains *Trapa macropoda* MIKI  $\times 1$ .  
 I Seed remains of *Sapium sebiferum* ROXB. var. *pleistoceaca* MIKI  $\times 2$ .  
 J Leaf remains of *Ilex cornuta* LDL. et PAXT.  $\times 1$ .  
 K Remains of *Camellia japonica* L.  $\times 1$ : a fragment of exocarp, b young fruit, c seed.  
 L Leaf remains of *Neolitsea aciculata* KOIDZ.  $\times 1$ .  
 M Remains *Aesculus* sp.: a leaf stalk  $\times 1$ , b scale leaf of bud  $\times 1$ , c fragment of testa  $\times 1$ , d surface view of seed epidermis  $\times 333$ .  
 N Fruit remain of *Acer crataegifolium* S. et Z.  $\times 1$ .  
 O Seed remains of *Vitis* sp.  $\times 2$ .  
 P Seed remains *Styrax japonicum* S. et Z.  $\times 1$ .  
 Q Leaf remains of *Elaeagnus* sp.  $\times 1$ .

16\* *Corylopsis epigyna* MIKI n. sp. Syn. *Distylium racemosum* S. et Z. in MIKI (1937) 316 Fig. L-N.

A few fruit on spike, peduncle thick and short. Capsule 8 mm long, 7 mm wide, enclosed with receptacle only at base. Seed 5-6 mm long, 3 mm wide. Capsule is alike to *Hamamelis*, though distinguished by thick spike, and different from other known species of *Corylopsis* by short receptacle.

#### c Floral composition and its characters

It is a noticeable fact that the floral composition is the same as the Lower Pleistocene flora in Yamasiro (12) as well as the Upper Pliocene flora at Akasi (13), where *Paliurus*, *Zelkora*, *Sapium* etc. are common. It is very interesting to find many remains of *Paliurus* in the basement clay, though it is rare in the upper part of the bed, from which such as *Abies*, *Chamaecyparis*, *Tsuga*, *Pinus* etc. are found.

#### d Age and climate

The plant bed seems to be Lower Pleistocene in geological age as has been stated (16), except the basement clay bed, which seems to be a little older, possibly to be the Upper Pliocene, on account of the domination of the *Paliurus* and vivianite particles. Climate of this flora may be referred to that of the present time, on account of the existence of abundant evergreen forest trees viz. *Quercus gilva* BL. (Fig. 4 N-P), *Camellia japonica* L. (Fig. 5 K) and *Neolitsea aciculata* KOIDZ. (Fig. 5 L) which are rather common in Kinki District at present.

### C THE LIGNITE BED OF SIMOKURADA

#### a General

The fossil bed lies about 12 km south-west of Yokohama and close to Totuka Station. The bed is laid upon the marin Naganuma Beds, which contain a rich molluscan fauna and under the plant bed of Yokohama. The bed is made of three lignite seams alternating with silts, each layer being about 20-30 cm in thickness.

The lignite seams are probably of allocthonous origin as they are made of many branches and pumices, while they contain no *Sphagnum*-remain.

#### b Plant remains: Table 4; Fig. 6-7, Pl. IV E, I

TABLE IV

	Occurrence	Remains	Distribution	Characters of identification
Coniferae				
Pinaceae				
1 <i>Pinus Armardi</i> FRANCH. (Pl. IV E, Fig. 6 C-D)	A	S	C-J	Seed elliptical, testa constituted with thickwalled pitted cells

TABLE IV (Continued)

	Occurrence	Remains	Distribution	Characters of identification
Dicotyledoneae				
Betulaceae				
2 <i>Alnus japonica</i> S. et Z. (Fig. 6 I)	C	F	J-Y	Shape and size of cone-like catkins and seed
Fagaceae				
3 <i>Fagus Hayatae</i> PALIB. (Fig. 6 F-H)	A	F.S.L	F	Serrated leaf and short pedicellated cupule
Ulmaceae				
4 <i>Zelkova Ungerii</i> KOVATS. (Fig. 6 B)	C	F.L	I	Crenate margin of leaf
Nymphaeaceae				
5 <i>Euryale ferox</i> SALISB. (Fig. 7 H)	C	S	O	Size and shape of seed, and shape of epidermal cells of testa
6 <i>Nelumbo nucifera</i> GAERTN. (Fig. 7 F)	A	L.Rh	O	Radiated nervation, recurved spines on the petiole and scar of fascicles of roots on rhizome
7 <i>Nuphar</i> cf. <i>akashiensis</i> MIKI. (Fig. 7 G)	C	S		Small size of seed
Ceratophyllaceae				
8 <i>Ceratophyllum demersum</i> L. (Fig. 7 I)	R	S	O	Remains of peculiar spined seed
Magnoliaceae				
9 <i>Magnolia Kobus</i> DC. (Fig. 6 N)	R	S	H-Y	Cordate seed without dorsal striation
Leguminosae				
10 <i>Wistaria floribunda</i> DC. (Fig. 6 J)	R	L.Sh	O	Petiole with puberulus, winter bud with constricted scales
Rutaceae				
11 <i>Fagara schinifolia</i> ENGL. (Fig. 6 M)	R	S	J-H	Small areolated testa and long grooved ventral hilum
Aquifoliaceae				
12 <i>Ilex cornuta</i> LDL. et PAXT. (Fig. 6 E)	R	L	I-C	Spiny fragment of leaf and epidermal structure of underside
Aceraceae				
13 <i>Acer palmatum</i> THUNB. (Fig. 6 L)	R	S	O	Small semiglobosed fruit
Rhamnaceae				
14 <i>Paliurus nipponicus</i> MIKI (Fig. 6 A)	R	F.Sh	I	Entire wing of fruit
Theaceae				
15 <i>Stuartia pseudocamellia</i> MAX. (Fig. 6 K)	R	F	J-H	Shape and size of capsule remains
Elaeagnaceae				
16 <i>Elaeagnus</i> sp. (Fig. 6 P-Q)	R	L.Sh	O	Remains of stellate hairs on the leaf

TABLE IV (Continued)

	Occurrence	Remains	Distribution	Characters of identification
17* <i>Trapa bicerata</i> MIKI n. sp. (Pl. IV I, Fig. 7 B)	A	F		Horn distinctly higher than the position of stigma
18 <i>Trapa incisa</i> S. et Z. (Fig. 7 A)	C	F	O	Small four horned fruit
19 <i>Trapa macropoda</i> MIKI (Fig. 7 C)	A	F		Large four horned fruit with long axial part under horns
Halorrhagaceae				
20 <i>Myriophyllum</i> sp. (Fig. 7 D)	R	L	O	Pinnate leaf remains
Styracaceae				
21 <i>Styrax obassia</i> S. et Z. (Fig. 6 O)	A	S	O	Large globular seed with basal hilum and a few striations
Pedaliaceae				
22 <i>Trapella sinensis</i> OLIV. (Fig. 7 E)	C	F	O	Tentacle-like appendage on the top of fruit
Monocotyledoneae				
Sparganiaceae				
23 <i>Sparganium</i> sp. (Fig. 7 M)	C	S	O	Peculiar shaped endocarp remains
Najadaceae				
24 <i>Najas tenuicaulis</i> MIKI. (Fig. 7 N-O)	A	S	H	Ovoid seed and pit-canalled cell of testa
Potamogetonaceae				
25 <i>Potamogeton Maackianus</i> BENN. (Fig. 7 K)	A	S.F	O	Central grooved large seed
26 <i>Potamogeton malaianus</i> MIQ. (Fig. 7 L)	R	S	O	Teethed peculiar small seed
27 <i>Potamogeton pectinatus</i> L. (Fig. 7 J)	C	S.F	O	Seed semiobovate, entire
Gramineae				
28 <i>Sasa</i> sp. (?)	R	H	O	

17\* *Trapa bicerata* MIKI n. sp. Two horned fruit; 2-2.5 cm height, 2-2.5 cm wide, with distinct axial part under the horns. The chief diagnostic characters are apex of horn distinctly higher than the position of stigma.

#### c Floral composition and its characters

There are many water plants as shown in fig. 7. Extinct species in the bed attain 25%, and as a striking fact *Ilex cornuta* (Fig. 6 E) and *Paliurus nipponicus* (Fig. 6 A) are absent except in the lowest lignite layer. The mode of occurrence corresponds very well to that of the Lower Pleistocene flora in Yamasiro.



Fig. 6. Plant remains in the lignite beds of Simokurada.

- A Remains of *Paliurus nipponicus* MIKI  $\times 1$ : a fruit, b twig.  
 B Remains of *Zelkova Unger* KOVATS.: a leaves  $\times 1$ , b fruit  $\times 4$ .  
 C-D Seed remains of *Pinus Armandi* FRANCH.: C seed  $\times 1$ , D surface view of seed epidermis  $\times 100$ .  
 E Leaf remain of *Ilex cornuta* LDL. et PAXT.: a  $\times 1$ , b epidermis of under-side  $\times 333$ .  
 F-H Remains of *Fagus Hayatae* PALIB.  $\times 1$ : F seeds, G cupule, H leaves.  
 I Remains of *Alnus japonica* S. et Z.: a cones  $\times 1$ , b scales  $\times 2$ , c seeds  $\times 2$ .  
 J Remains of *Wistaria floribunda* DC.: a scale leaf from winter bud  $\times 2$ , b stalk  $\times 1$ , c leaflet  $\times 1$ .  
 K Fruit remains of *Stuartia pseudocamellia* MAX.  $\times 1$ .  
 L Fruit remains of *Acer palmatum* THUNB.  $\times 1$ .  
 M Seed remains of *Fagara schinifolia* ENGL.  $\times 2$ .  
 N Seed remains of *Magnolia Kobus* DC.  $\times 1$ .  
 O Seed remains of *Styrax obassia* S. et Z.  $\times 1$ .  
 P Leaf remains of *Elaeagnus* sp.: a  $\times 1$ , b star-shaped hair  $\times 50$ .  
 Q Twig of *Elaeagnus* sp.?  
 R Branched spine of *Gleditschia* sp. (?)



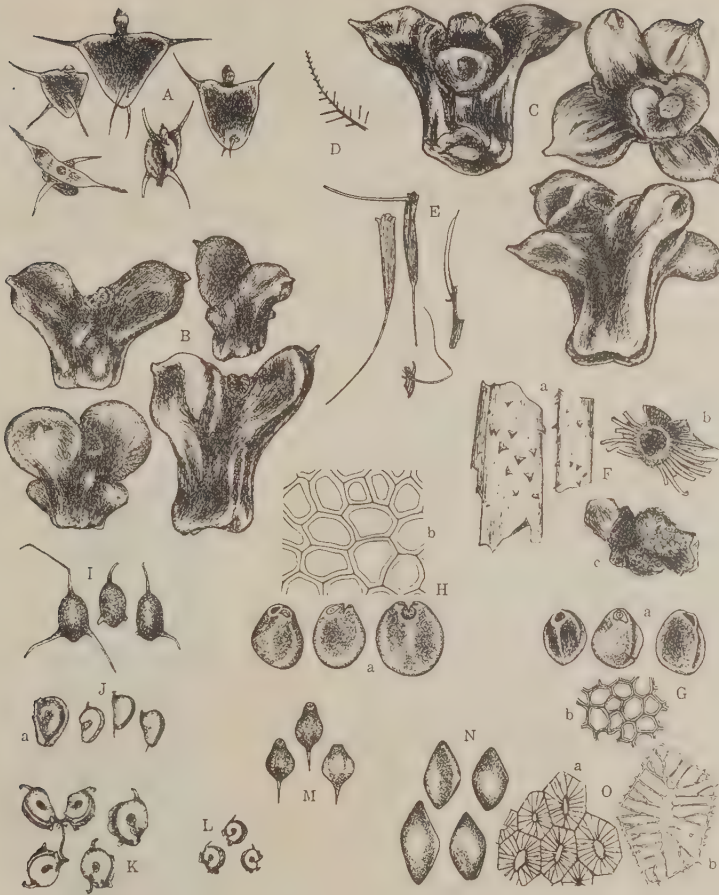


Fig. 7. Plant remains in the lignite beds of Simokurada.

- A Fruit remains of *Trapa incisa* S. et Z.  $\times 1$ .  
 B Fruit remains of *Trapa bicerata* MIKI n. sp.  $\times 1$ .  
 C Fruit remains of *Trapa macropoda* MIKI  $\times 1$ .  
 D Leaf remains of *Myriophyllum* sp.  $\times 2$ .  
 E Fruit remains of *Trapella sinensis* OLIV.  $\times 1$ .  
 F Remains of *Nelumbo nucifera* GAERTN.: a stalk with hooked spine  $\times 1$ , b central part of leaf  $\times 1$ , c nodal part of rhizome  $\times 1$ .  
 G Seed remains of *Nuphar* cf. *akashiensis* MIKI: a  $\times 2$ , b surface view of seed epidermis  $\times 100$ .  
 H Seed remains of *Euryale ferox* SALISB.: a  $\times 1$ , b surface view of seed epidermis  $\times 100$ .  
 I Seed remains of *Ceratophyllum demersum* L.  $\times 2$ .  
 J Remains of *Potamogeton pectinatus* L.  $\times 2$ : a fruit.  
 K Seed remains of *Potamogeton Maackianus* BENN.  $\times 2$ .  
 L Seed remains of *Potamogeton malayanus* MIQ.  $\times 2$ .  
 M Seed remains of *Sparganium* sp.  $\times 2$ .  
 N-O Remains of *Najas tenuicaulis* MIKI: N  $\times 2$ , O surface view of seed epidermis, a  $\times 100$ , b  $\times 333$ .

#### d Age and climate

Geological age of the underlying marine Naganuma Beds is regarded to be either Lower Pleistocene or Upper Pliocene by geologists. So far as the floral composition is concerned, it is certain that the flora corresponds to that of the Lower Pleistocene of Yamasiro as has been already stated by the writer (12).

The climate at that age as shown by this flora was probably like that of the recent as there occurred *Potamogeton malianus* MIQ. (Fig. 7 L), *Euryale ferox* SALISB. (Fig. 7 H) and *Trapella sinensis* OLIV. (Fig. 7 E).

### D THE CONIFER BED OF EKODA

#### a General

The fossil bed studied, lies at Nakano in Tokyo (Fig. 8). The plant remains of the bed were obtained during the excavation of water supply work and drainage work of the River Myosyozi. The profile of sedimentation at the plot of excavation of the former is shown in fig. 9. The bed is covered by the Akatuki or the Kwantō loam and passes downwards to the Yamanote Gravels of the Tokyo Stage. The bed consists of mud or clay, occasionally with a peat of *Drepanocladus* containing *Larix*.

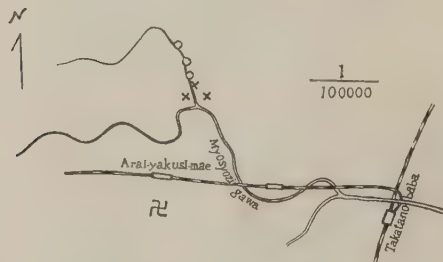


Fig. 8. The map showing the locality of the conifer bed and the neolithic bed of Ekoda.

- The localities of neolithic flora.  
 ××× The localities of conifer flora.

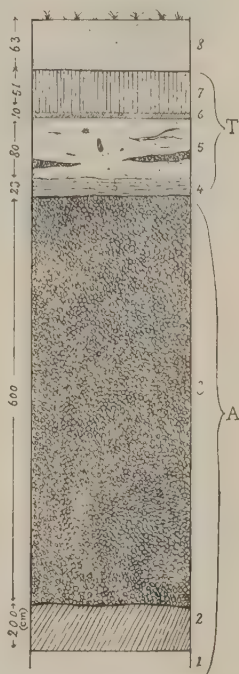


Fig. 9. Profile of the conifer bed of Ekoda (After Mr. N. NAORA).

1. Bluish clay.
  2. Bluish fine sand.
  3. Yamanote gravel layer.
  4. Yellowish gray clay.
  5. Conifer bed.
  6. White gray clay.
  7. Akatuti or Kwantō loam.
  8. Soil (Black coloured).
- A. Tokyo Stage.  
 T. Tatikawa Stage.

b Plant remains: Table 5; Fig. 10 A-R, Pl. III, Pl. IV C, F, G, H, K

TABLE V

	Occur- rence	Remains	Distri- bution	Characters of identification
Musci				
1 <i>Drepanocladus exanulatus</i> (GUMB.) WARNST. (Pl. III U, Fig. 10 A-C)	A	Sh	O.H (1500-2000 m)	Basal cells of leaf large
Coniferae				
Taxaceae				
2 <i>Taxus cuspidata</i> S. et Z. (Pl. III D, Fig. 10 E-F)	R	S	H (1500-2000 m)	Ovate seed with round hilm, epidermis is alike to that of the recent one
Pinaceae				
3 <i>Abies Mariesii</i> MAST. (Pl. III P-Q, Fig. 10 D)	C	S.F.L.Sh	H (2000-2500 m)	Wing of seed and short bract correspond to the recent one
4 <i>Larix Kaempferi</i> SARG. (Pl. III A-C)	A	S.F.L.Sh	H (1500-3000 m)	Dimorphic shoot and thin recurved scales
5 <i>Picea bicolor</i> MAYR (Pl. III Eb, Fb, Ia)	C	S.F.L.Sh	H (1500-2000 m)	Tetragonal leaf and entire large scales
6 <i>Picea hondoensis</i> MAYR (Pl. III Ea, Fa, H, G, J)	C	S.F.L.Sh	H (1500-2000 m)	Curved and flattend leaves and crispate small scales
7 <i>Pinus koraiensis</i> S. et Z. (Pl. III K-L)	C	S.L	M.H (1000-2000 m)	Obovate seed and five fascicles of large trigona leaves
8 <i>Tsuga diversifolia</i> MAST. (Pl. III M-O)	C	S.F.L.Sh	H (1500-2500 m)	Spur of hair remains on shoot, delicate leaf and cones
Dicotyledoneae				
Salicaceae				
9 <i>Salix</i> cf. <i>Bakko</i> KIMURA (Fig. 10 J)	R	L	H (1000-1500 m) Y	Size and shape of leaf
Betulaceae				
10 <i>Alnus tinctoria</i> SARG. (Pl. III R)	C	S.F	O.H (1000-1500 m)	Short pedicellate catkin and size and shape of seed
11 <i>Carpinus erosa</i> BL. (Pl. IV K, Fig. 10 G)	R	S.F.L	J.H (1500-2000 m) Y	Seed enclosed by bract base
Fagaceae				
12 <i>Fagus crenata</i> BL. (Fig. 10 I)	R(C)	L	J.H (1000-1500 m) Y	Undulated margin and peculiar nervation
13 <i>Quercus crispula</i> BL. (Pl. IV F, Fig. 10 Q)	R(C)	L	O.H (1000-1500 m)	Serrate margin and short petiole
Rosaceae				
14 <i>Spiraea</i> sp. (Fig. 10 H)	R	F	O	Remains of compound peculiar carpels
Tiliaceae				
15 <i>Tilia japonica</i> SIMK. (Pl. IV H, Fig. 10 K)	R(C)	L	J.H (1000-1500 m) Y	Palmately veined top of petiole and remains of inflorescence bract

TABLE V (Continued)

	Occurrence	Remains	Distribution	Characters of identification
Monocotyledoneae				
Potamogetonaceae				
16 <i>Potamogeton gramineus</i> L. (Pl. III S)	C	S	O.H (1000-1500m)	Shape and size of seed
Gramineae				
17 <i>Phragmites communis</i> TRIN. (Pl. IV C, Fig. 10 P)	C	H	O	Peculiar epidermal cells as in Fig. 10 P
Cyperaceae				
18 <i>Carex rhinophylla</i> C. A MEY (Pl. III T)	C	S.F	O.H (1000-1500m)	Achene with curved style
19 <i>Scirpus</i> sp. (Fig. 10 M-N)	R	S	O	Achenes with appendages
Juncaceae				
20 <i>Luzula</i> cf. <i>plumosa</i> E. MEY (Fig. 10 O)	C	S.F	H (0-2000m)	Appendage of seed in capsule
Iridaceae				
21 <i>Iris laevigata</i> FISH. (Fig. 10 L)	R	S	H (0-1500m)	Shape of seed and its epidermal cells

### c Floral composition and its characters

It is the most striking fact that the remains of the cold climate are most abundant there. The coniferous remains are most predominating, not only in genera, but also in amount. Species existing in Central Japan, at the height of 1500-2500 m above sea-level represent these remains; a similar tree community as the fossil remains may be seen in Mt. Sirane, Prov. Kai, altitude 1500-2000 m (27).

### d Age and climate

The bed represents the extension of Tatikawa Stage as informed by Dr. IKEBE and Dr. SUZUKI, and the age was designated to be the Upper Pleistocene by MAKIYAMA (11). The floral composition of the bed is very rich in conifer, and it contains even *Picea bicolor* var. *reflexa* SHIRASAWA et KOYAMA (Pl. III Ia), which is now confined only to Mt. Sirane, Prov. Kai. As the bed is older than the neolithic floral bed described below (Fig. 11) in the order of sedimentation, it is very conceivable, that the bed corresponds to the age mentioned above. We may designate this age as "the Conifer Age" of the Upper Pleistocene. The cool and humid climate of the bed is very interesting, the origin of which will be discussed in the later paragraph.

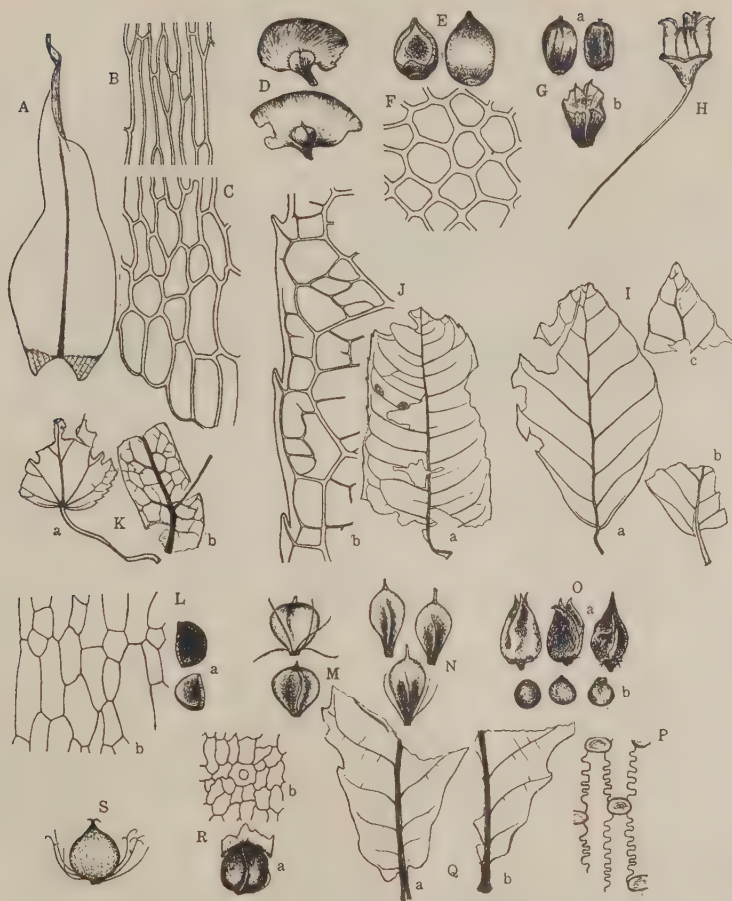


Fig. 10. Plant remains from the Conifer bed of Ekoda (excl. S).

- A-C Leaf remains of *Drepanocladus exanulatus* (GUMB.) WARNST.: A leaf  $\times 20$ , B cell shape of middle part of lamina  $\times 333$ , C cell shape of basal part of lamina  $\times 333$ .
- D Scale remains of *Abies Mariesii* MAST.  $\times 1$ .
- E-F Seed remains of *Taxus cuspidata* S. et Z.: E  $\times 2$ , F surface view of seed epidermis  $\times 100$ .
- G Remains of *Carpinus erosa* BL.  $\times 2$ : a seeds, b bract.
- H Fruit remain of *Spiraea* sp.  $\times 4$ .
- I Leaf remains of *Fagus crenata* BL.  $\times 1$ .
- J Leaf remains of *Salix* cf. BAKKO KIMURA: a  $\times 1$ , b margin  $\times 10$ .
- K Remains of *Tilia japonica* SIMK.  $\times 1$ : a leaf, b bract subtending the peduncle.
- L Seed remains of *Iris laevigata* FISH.: a  $\times 1$ , b surface view of seed epidermis  $\times 100$ .
- M-N Seed remains of *Scirpus* sp.  $\times 4$ .
- O Remains of *Luzula* cf. *plumosa* E. MEY  $\times 4$ : a seed, b fruit.
- P Surface view of halm epidermis of *Phragmites communis* TRIN.  $\times 333$ .
- Q Leaf remains of *Quercus crispula* BL.  $\times 1$ .
- R An unidentified seed remain: a  $\times 2$ , b part of wing enlarged  $\times 60$ .
- S Seed remain of *Fuirena tokyoensis* MIKI n. sp. from Tokyo Bed  $\times 4$ .



## E THE NEOLITHIC BED OF EKODA

## a General

The site of the bed is close to the conifer bed just mentioned (Fig. 8), the mode of deposition being shown in fig. 11. The bed consists of peaty

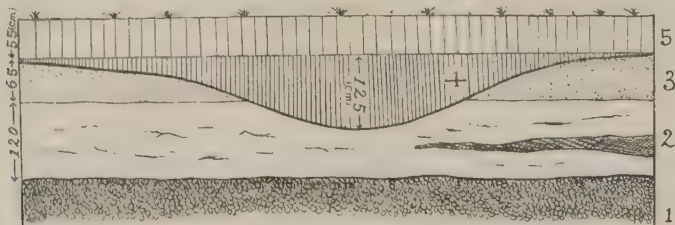


Fig. 11. Profile of the neolithic bed of Ekoda (Diagrammatic) (After Mr. N. NAORA).

- |                           |                 |
|---------------------------|-----------------|
| 1. Yamanote gravels.      | 2. Conifer bed. |
| 3. Akatuti or Kwano loam. | 4. Fossil bed.  |
| 5. Soil.                  |                 |

mud and sandy silt associated with many neolithic remains.<sup>(1)</sup> The separation of the plant remains is performed easily by washing the mud or silt on the sieve.

## b Plant remains: Table 6; Fig. 12 A-Y, Pl. IV D, G, M

TABLE VI

	Occurrence	Remains	Distribution	Characters of identification
Coniferae				
Taxaceae				
1 <i>Cephalotaxus drupacea</i> S. et Z. (Fig. 12 A)	R	S	O	Shape and size of seed
Pinaceae				
2 <i>Pinus densiflora</i> S. et Z.	R	F	H	Cone remains, size and shape of scales
Dicotyledoneae				
Juglandaceae				
3 <i>Juglans Sieboldiana</i> MAX. (Pl. IV M)	A	F	O	Size and shape of nut-shells
var. <i>cordiformis</i> MAK. (Pl. IV Ma)	R	F	H-Y	Cordate nut-shells
Betulaceae				
4 <i>Alnus japonica</i> S. et Z.	C	F.S	H-Y	Size and shape of scale of catkins
5 <i>Carpinus Tschonoskii</i> MAX. (Fig. 12 D)	A	F	O	Size and shape of nutlet

(1) Many Jomon (cord and mat pattern) Pottery etc. are found.

TABLE VI (Continued)

	Occurrence	Remains	Distribution	Characters of identification
6 <i>Corylus heterophylla</i> FISCH. (Fig. 12 C)	C	F	O	Shape and size of acorn like nut
Fagaceae				
7 <i>Quercus crispula</i> BL. (Pl. IV G)	C	S.F	J-Y	Large cupule, imbricated large scales
8 <i>Quercus serrata</i> THUNB. (Fig. 12 B)	C	S.F	O	Small cupule, imbricated fine scales
Ulmaceae				
9 <i>Aphananthe aspera</i> PLANCH. (Fig. 12 E)	C	S	O	Each epidermal cell of testa with a wart
Magnoliaceae				
10 <i>Magnolia Kobus</i> DC. (Fig. 12 J)	C	S	J-Y	Cordate seed without dorsal striation
Rosaceae				
11 <i>Prunus</i> cf. <i>serrulata</i> LINDL. (Fig. 12 I)	C	S	J-Y	Shape and size of endocarp remains
12 <i>Stephanandra incisa</i> ZABEL (Fig. 12 K)	C	S	H	Size and shape of seed remains
Leguminosae				
13 <i>Wistaria floribunda</i> DC.	A	F.Sh	O	Winter bud and pod remains
Rutaceae				
14 <i>Phellodendron amurense</i> RUPR. (Fig. 12 F)	C	S	O	Semiovate seed with reticulated surface of testa
15 <i>Xanthoxylum piperitum</i> DC. (Fig. 12 G)	C	S	O	Apical hilm and reticulated surface of testa
Euphorbiaceae				
16 <i>Mallotus japonicus</i> MUELL-ARG. (Fig. 12 H)	C	S	O	Globular seed with jaggy crest
Staphyleaceae				
17 <i>Staphylea Bumalda</i> DC. (Fig. 12 S)	A	S	O	Obovate lustred seed with distinct hilm
Aceraceae				
18 <i>Acer palmatum</i> THUNB. (Fig. 12 Nb)	R	F	O	Small semiglobose fruit
19 <i>Acer pictum</i> THUNB. (Fig. 12 Na)	R	F	O	Broad wing with large flat fruit
Hippocastanaceae				
20 <i>Aesculus turbinata</i> BL. (Fig. 12 R b, c)	A	F.S.L	J-Y	Size and structure of fruit and seed
var. <i>lineata</i> MIKI (nov) (Pl. IV D, Fig. 12 R a)	C	F.S(?)		Fruit with ridge at suture line
Sapindaceae				
21 <i>Sapindus Mukorossi</i> GAERTN. (Fig. 12 O)	C	F.S	O	Shape and structure of fruit and seed
Rhamnaceae				
22 <i>Berchemia racemosa</i> S. et Z. (Fig. 12 M)	C	F	O	Compressed oblong fruit

TABLE VI (Continued)

	Occurrence	Remains	Distribution	Characters of identification
Vitaceae				
23 <i>Vitis</i> sp. (Fig. 12 L)	R	S	O	Size and shape of seed remains
Cornaceae				
24 <i>Cornus brachypoda</i> C. A. MEY (Fig. 12 P)	A	F	O	Sulcate endocarp remains
25 <i>Cornus controversa</i> HEMSL. (Fig. 12 Q)	A	F	O	Endocarp remains with crossed striation at the base
Styracaceae				
26 <i>Styrax japonicum</i> S. et Z. (Fig. 12 T)	C	S	O	Small elliptical seed with ventral hilm and a few striations
27 <i>Styrax obassia</i> S. et Z. (Fig. 12 U)	C	S	O	Shape alike as the former though large in size
Verbenaceae				
28 <i>Clerodendron tricotomum</i> THUNB. (Fig. 12 V)	C	S	O	Crescent-formed seed with dorsal reticulation
Monocotyledoneae				
Sparganiaceae				
29 <i>Sparganium</i> sp. (Fig. 12 X)	A	S	O	Remains of peculiar endocarp
Potamogetonaceae				
30 <i>Potamogeton oxyphyllus</i> MIQ. (Fig. 12 Y)	R	S	O	Plano-convex seed
Cyperaceae				
31 <i>Carex</i> sp. (Fig. 12 W c)	R	S	O	Triangular achene with long curved style
32 <i>Cyperus</i> sp. (Fig. 12 W a)	R	S	O	Achene without perianth
33 <i>Scirpus</i> sp. (Fig. 12 W b)	R	S	O	Achene with perianth

### c Floral composition and climate

It is quite peculiar to see no evergreen tree here, and the flora is composed only of the living members. The climate of the age seems to be slightly colder than now, as those indigenous temperate trees such as *Aesculus*, *Quercus crispula* BL. occur.

## F THE PEAT BED OF AZUTI

### a General

The bed is laid in the eastern margin of Ibanaike in Lake Biwa. The deposition of peat in fig. 13 was demonstrated by a soil boring. The plant remains from the upper peat are studied.

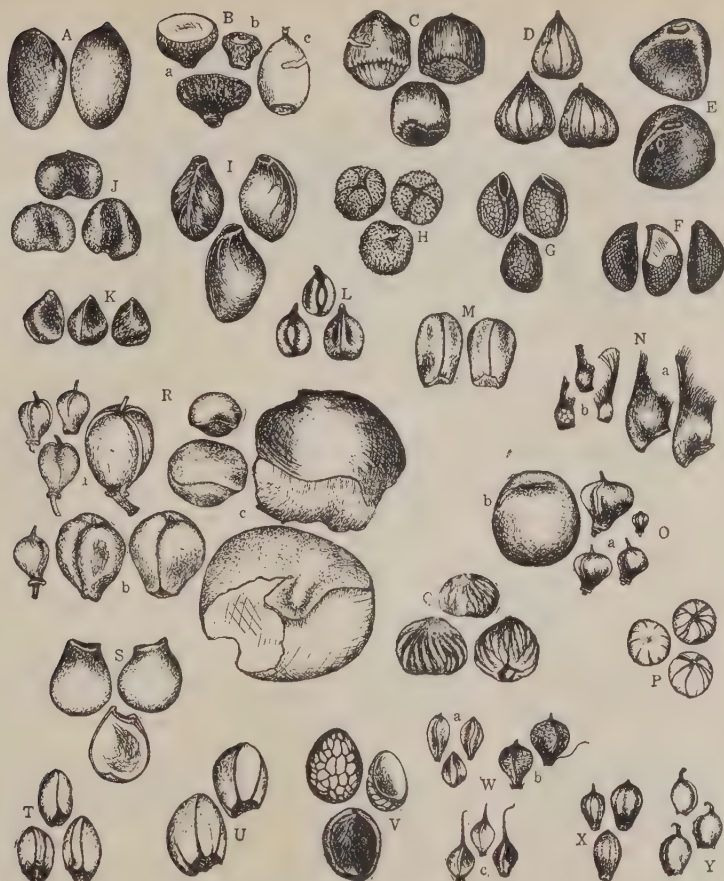


Fig. 12. Plant remains in the neolithic bed of Ekoda.

- A Seed remains *Cephalotaxus drupacea* S. et Z.  $\times 1$ .  
 B Remains of *Quercus serrata* THUNB.  $\times 1$ : a cupule, b young fruits, c nut.  
 C Seed remains of *Corylus heterophylla* FISCH. var. *japonica* KOIDZ.  $\times 1$ .  
 D Fruit remains of *Carpinus Tschonoskii* MAX.  $\times 2$ .  
 E Seed remains of *Aphananthe aspera* PLANCH.  $\times 2$ .  
 F Seed remains of *Phellodendron amurense* RUPR.  $\times 2$ .  
 G Seed remains of *Xanthoxylum piperitum* DC.  $\times 2$ .  
 H Seed remains of *Mallotus japonicus* MUELL. ARG.  $\times 2$ .  
 I Seed remains of *Prunus* cf. *serrulata* LINDL.  $\times 2$ .  
 J Seed remains of *Magnolia Kobus* DC.  $\times 1$ .  
 K Seed remains of *Stephanandra incisa* ZABEL  $\times 4$ .  
 L Seed remains of *Vitis* sp.  $\times 2$ .  
 M Fruit remains of *Berchemia racemosa* S. et Z.  $\times 2$ .  
 N Fruit remains of *Acer* sp.  $\times 1$ : a *Acer pictum* THUNB., b *Acer palmatum* THUNB.  
 O Remains of *Sapindus Mukorossi* GAERTN.  $\times 1$ : a young fruits, b seed.  
 P Endocarp remains of *Cornus brachypoda* C. A. MEY.  $\times 2$ .  
 Q Endocarp remains of *Cornus controversa* HEMS.  $\times 2$ .  
 R Remains of *Aesculus turbinata* BL.  $\times 1$ : a young fruit of var. *lineata* MIKI (nov.), b young fruit of typical one. c seeds.  
 S Seed remains of *Staphylea Bumalda* DC.  $\times 2$ .  
 T Seed remains of *Styrax japonicum* S. et Z.  $\times 1$ .  
 U Seed remains of *Styrax obassia* S. et Z.  $\times 1$ .  
 V Seed remains of *Clerodendron tricotomum* THUNB.  $\times 2$ .  
 W Seed remains of Cyperaceae: a *Cyperus* sp.  $\times 4$ , b *Scirpus* sp.  $\times 4$ , c *Carex* sp.  $\times 2$ .  
 X Seed remains of *Sparganium* sp.  $\times 2$ .  
 Y Seed remains of *Potamogeton oxyphyllus* MIQ.  $\times 2$ .

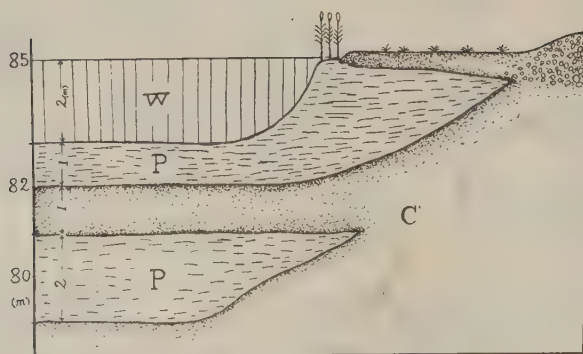


Fig. 13. Profile of the peat bed of Azuti (Diagrammatic).

W water; P peat; C bluish clay

b Plant remains: Table 7; Fig. 14 A-Z

TABLE VII

	Occurrence	Remains	Distribution	Characters of identification
Coniferae				
Taxaceae				
1 <i>Torreya nucifera</i> S. et Z. (Fig. 14 A)	R	S	H	Size and rough surface of nut
Dicotyledoneae				
Salicaceae				
2 <i>Salix glandulosa</i> SEEM.	R	T.L	O	Remains of basal grand of lamina
Betulaceae				
3 <i>Alnus japonica</i> S. et Z.	A	F.S.Sh	H-Y	Size and shape of catkin and seed
4 <i>Carpinus Tschonoskii</i> MAX. (Fig. 14 B)	R	F	O	Size and shape of seedlike nutlet
Fagaceae				
5 <i>Quercus glauca</i> THUNB. (Fig. 14 C)	R	S.F	O	Scales of cupule arranged in concentric ring and short style
6 <i>Quercus serrata</i> THUNB.	C	S.F.Sh	O	Small cupule imbricated by fine scales
Ulmaceae				
7 <i>Aphanathe aspera</i> PLANCH.	C	S	O	Size and shape as in fig. 12 E
Loranthaceae				
8 <i>Viscum coloratum</i> NAKAI (Fig. 14 E)	A	S.L.Sh	O	Epidermal layer of leaf and seed
Polygonaceae				
9 <i>Polygonum Thunbergii</i> S. et Z. (Fig. 14 J)	A	S	O	Shape and size of seed



Table VII (Continued)

	Occurrence	Remains	Distribution	Characters of identification
Nymphaeaceae				
10 <i>Nuphar subintegerrimum</i> MAK. (Fig. 14 H b)	A	S	H	Tetragonal shape of epidermis of testa
11 <i>Nymphaea tetragona</i> GEORG. (Fig. 14 Ha)	R	S	O	Waved epidermis of testa
Menispermaceae				
12 <i>Cocculus trilobus</i> DC. (Fig. 14 Fb)	C	S	O	Seed grub shaped
Magnoliaceae				
13 <i>Magnolia Kobus</i> DC. (Fig. 14 D b)	C	S	J-Y	Cordate seed without dorsal striation
14 <i>Magnolia obovata</i> THUNB. (Fig. 14 D a)	R	S	J-Y	Seed with dorsal striations
Rosaceae				
15 <i>Prunus</i> cf. <i>scrrulata</i> LINDL.	R	S	J-Y	Size and shape as in fig. 12 I
16 <i>Rosa polyantha</i> S. et Z. (Fig. 14 I)	C	F.Sh	J-Y	Fruit with peculiar seed in it
Leguminosae				
17 <i>Wistaria floribunda</i> DC. (Fig. 14 K)	A	F.L.Sh	O	Peculiar shape and size of winter bud and stalk with pluvinus
Rutaceae				
18 <i>Phellodendron amurense</i> RUPR. (Fig. 14 Nb)	R	S	O	Semiovalte seed with fine reticulated surface
19 <i>Xanthoxylum piperitum</i> DC. (Fig. 14 N a)	R	S	O	Apical hilm and reticulated surface of seed
Euphorbiaceae				
20 <i>Mallotus japonicus</i> MUELL-ARG. (Fig. 14 M)	C	S	O	Testa with jagged crest
Aceraceae				
21 <i>Acer palmatum</i> THUNB.	R	F	O	Size and shape as in fig. 12 N b
Sapindaceae				
22 <i>Sapindus Mukorossi</i> GAERTN. (Fig. 14 P)	R	S	O	Elliptic seed with straight hilm at the base
Rhamnaceae				
23 <i>Berchemia racemosa</i> S. et Z. (Fig. 14 L)	A	F	O	Compressed oblong fruit
24 <i>Frangula crenata</i> MIQ. (Fig. 14 R)	A	S	O	Compressed ovate seed with ventral striation and apical hilm
Vitaceae				
25 <i>Vitis</i> sp. (Fig. 14 O)	R	S	O	Dorsal crest and long beak
Umbelliferae				
26 <i>Cicuta virosa</i> L. (Fig. 14 Q)	C	S	O	Ribbed seed
Cornaceae				
27 <i>Cornus brachypoda</i> C. A. MEY (Fig. 14 G b)	R	F	O	Sulcate endocarp remains

TABLE VII (Continued)

	Occurrence	Remains	Distribution	Characters of identification
28 <i>Cornus controversa</i> HEMS. (Fig. 14 G a)	R	F	O	Globular endocarp remains with crossed striation at the base
Styracaceae				
29 <i>Styrax japonicum</i> S. et Z. (Fig. 14 Ta)	A	S	O	Seed small
30 <i>Styrax obassia</i> S. et Z. (Fig. 14 Tb)	R	S	O	Seed large
Symplocaceae				
31 <i>Symplocos crataegoides</i> BUCH. (Fig. 14 S)	A	F	O	Excentric obovate nut with truncate basal end
Pedaliaceae				
32 <i>Trapella sinensis</i> OLIV. (Fig. 14 U)	R	F	O	Tentacle-like appedage on top of fruit
Cucurbitaceae				
33 <i>Actinostemma lobatum</i> MAX. (Fig. 14 V)	C	S	O	Shape of seed and its crest
Monocotyledoneae				
Sparganiaceae				
34 <i>Sparganium</i> sp. (Fig. 14 Za)	A	S	O	Remains of peculiar endocarp
Potamogetonaceae				
35 <i>Potamogeton perfoliatus</i> L. (Fig. 14 Zb)	R	S	O	Size and shape of seed
Najadaceae				
36 <i>Najas major</i> ALL. (Fig. 14 Y)	R	S	O	Narrow spindle-shaped seed
Cyperaceae				
37 <i>Scirpus</i> sp. (Fig. 14 W)	R	S	O	Achene with thread like perianth
Iridaceae				
38 <i>Iris laevigata</i> FISCH. (Fig. 14 X)	R	S	O	Size and shape of seed

#### c Floral composition and its characters

The plant remains are somewhat akin to those existing in this region, though there predominate deciduous woody plants over the evergreen tree, which is represented by a single species *Quercus glauca*. Most species in the bed such as *Alnus japonica* S. et Z., *Frangula crenata* MIQ., *Symplocos crataegoides* BUCH., *Styrax japonicum* S. et Z. etc. grow at present on the marshes or along the streams. Such a feature indicates a wide extension of the marshy habitat along the east side of the lake at that time.

#### d Age and climate

The age is quite new, the plant remains being practically a part of the recent flora, inclusive of one evergreen tree. The precise age, however, may not be determined without human relic. At all events the bed will be shown to be a little younger than the neolithic flora of Ekoda.

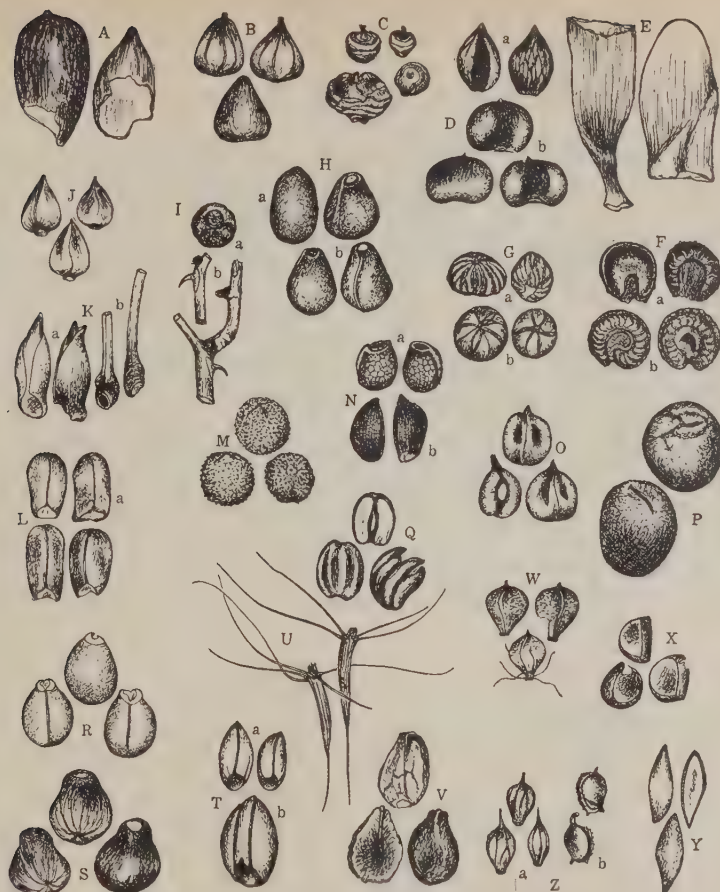


Fig. 14. Plant remains in the peat bed of Azuti (excl. Fa, La).

- A Seed remains of *Torrey nucifera* S. et Z.  $\times 1$ .  
 B Fruit remains of *Carpinus Tschonoskii* MAX.  $\times 2$ .  
 C Fruit remains *Quercus glauca* THUNB.  $\times 1$ .  
 D Seed remains of *Magnolia* sp.  $\times 1$ : a *Magnolia obovata* THUNB., b *Magnolia Kobus* DC.  
 E Leaf remains of *Viscum coloratum* NAKAI  $\times 1$ .  
 F Seed remains of *Cocculus trilobus* DC.  $\times 2$ : a from the plant bed near Katada.  
 G Fruit remains of *Cornus* sp.  $\times 2$ : a *Cornus controversa* HEMSL., b *Cornus brachypoda* C. A. MEY.  
 H Seed remains of *Nymphaeaceae*: a *Nymphaea tetragona* GEORG.  $\times 4$ , b *Nuphar subintegerrimum* MAK.  $\times 2$ .  
 I Remains *Rosa polyantha* THUNB.  $\times 1$ : a fruit, b branch.  
 J Seed remains of *Polygonum Thunbergii* S. et Z.  $\times 2$ .  
 K Remains *Wistaria floribrida* DC.: a knospe  $\times 2$ , b petiole of leaf  $\times 1$ .  
 L Fruit remains of *Berchemia racemosa* S. et Z.  $\times 2$ : a from the plant bed near Katada.  
 M Seed remains of *Mallotus japonicus* MUELL. ARG.  $\times 2$ .  
 N Seed remains of *Rutaceae*  $\times 2$ : a *Xanthoxylum piperitum* DC., b *Phellodendron amurense* RUPR.  
 O Seed remains of *Vitis* sp.  $\times 2$ .  
 P Seed remains of *Sapindus Mukorossi* GAERTN.  $\times 1$ .  
 Q Seed remains of *Cicuta virosa* L.  $\times 4$ .  
 R Seed remains of *Frangula crenata* MIQ.  $\times 2$ .  
 S Fruit remains of *Symplocos crataegoides* BUCH.  $\times 2$ .  
 T Seed remains of *Styrax* sp.  $\times 1$ : a *Styrax japonicum* S. et Z., b *Styrax Obassia* S. et Z.  
 U Fruit remains of *Trapella sinensis* OLIV.  $\times 1$ .  
 V Seed remains of *Actinostemma lobatum* MAX.  $\times 1$ .  
 W Seed remains of *Scirpus* sp.  $\times 4$ .  
 X Seed remains *Iris laevigata* FISCH  $\times 1$ .  
 Y Seed remains of *Najas major* ALL.  $\times 2$ .  
 Z Seed remains of *Sparganium* sp. (a) and *Potamogeton perfoliatus* L. (b).

#### IV. The change of flora since the Upper Pliocene in Japan

The knowledge of the Neogene flora is hitherto almost exclusively based upon the tuffaceous materials as poor prints. They are moreover very meagre and incomplete, and can hardly represent the actual status of vegetation at that age. As for instance, there were no reports of *Paliurus* and *Sapium* until today, whereas they are very common and widely distributed from the Upper Pliocene to the Lower Pleistocene, as my collections show.

Comparing the floral characters of all beds studied by the writer, fluctuations of following four characteristics are very noteworthy, namely: 1) the number of extinct species as a whole, 2) that of the arid habitat, 3) the water and marsh plants and 4) the conifers, as shown in tab. 8 and fig. 15. Though the statistical data are not quite regular, still they

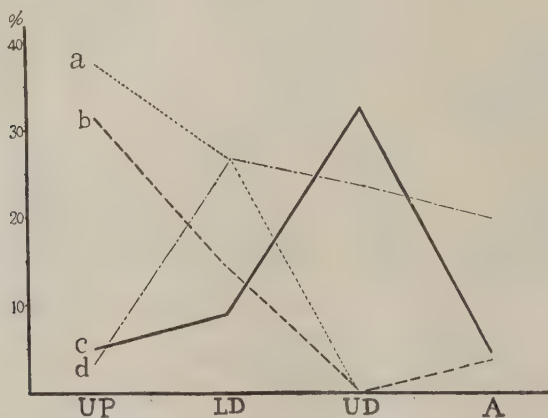


Fig. 15. Change of 4 floristic characters in 4 geological ages in % based upon the data of tab. 8.

- a Species extinct or not found in wild state in Japan.
- b Plant with spine, thorn or prickles.
- c Conifers.
- d Water and marsh plant.
- UP Upper Pliocene.
- LD Lower Pleistocene.
- UD Upper Pleistocene.
- A Recent.

may be seen that the percentage of extinct species as a whole gradually decrease through successive ages onward, just as in the case of the molluscan fauna (26).

The species with thorns, prickles or leafy spines are abundant in the Upper Pliocene, but declined rapidly through the successive ages. On the other hand the water and marsh plants increased rapidly since the Lower Pleistocene, and the occurrence of the conifer is quite remarkable, being predominant in the Upper Pleistocene.

TABLE VIII

		Upper Pliocene		Lower Pleistocene			Upper Pleistocene	Recent	
		Akasi	Hanaki	Yamasiro	Katada	Simokurada	Conif. Ekoda	Neol. Ekoda	Azuti
1	Extinct species	18(31%)	5(45%)	6(26%)	9(29%)	7(25%)	0	0	0
	Average	38%		27%			0	0	
2	Plant with spine or thorn	11(19%)	5(45%)	2 (9%)	6(19%)	4(14%)	0(?)	1(3%)	2(5%)
	Average	32%		14%			0	4%	
3	Conifers	6(10%)	0 (?)	1 (4%)	6(19%)	1(4%)	7(33%)	2(6%)	1(3%)
	Average	5%		9%			33%	4.5%	
4	Water or marsh plant	4 (7%)	0 (?)	7(30%)	2 (6%)	13(46%)	5(24%)	5(16%)	9(24%)
	Average	3.5%		27%			24%	20%	
Enumerated species		58	11	23	31	28	21	33	38
No. of genera		48	11	21	31	24	20	30	36

## V. Palaeogeographical consideration on the floral change in Japan

So far as we can deduce the ecological conditions of the beds from the plant remains, the decline of species with thorn, prickle or leafy spine since the Upper Pliocene, and the increasing water and marsh plants since the Lower Pleistocene, must be in accordance with the topographical changes of the habitat from the arid continental to the humid oceanic climate, as has been stated in my previous paper (13). The luxuriant growth of the conifer in the Upper Pleistocene of Ekoda is also worthy of note.



## A ON THE CONIFER FLORA AT EKODA

The conifer bed of Ekoda lies about 30 m above sea-level at present, whereas their floral composition corresponds to the height of about 1500–2000 m above sea-level, in the cloudy zone of Central Japan. The climate of the stage must have been, therefore, cold and humid. How then the climate of the age has been realized?

At a glance, the climate in general seems to be colder at some ages during the Pleistocene, as the remains of glaciation in Central Japan induced by YAMASAKI, OGAWA<sup>(1)</sup> and others would prove. NAKAI arrived also to a conclusion from the unusual distribution of conifer in Corea, that the temperature in the Pleistocene would be so low that *Pinus koraiensis* S. et Z. migrated to the plain of southern Corea, and *Pinus pumila* REGEL to the plain of middle Corea. KOIDZUMI arrived at a similar conclusion from the distribution of alpine plants in Japan.

The temperature seems, however, not so low in general, because the subtropical plants such as *Quercus gilva* BL., *Neolitsea aciculata* KOIDZ. and *Camellia japonica* L. exist uninterruptedly from the Lower Pleistocene up to the present. Besides there are found no glacial relic fauna in Japanese lakes (34). MAKIYAMA (11) states also that the marine molluscan remains in Kwanto have no records of so severe a climate as to be attributed to the extension of two large glaciers that occurred in Siberia. So the flora mentioned above is not satisfactorily explained by a general lowering of the temperature. An explanation which seems best to me is that the bed was deposited at a higher level about 1500 to 2000 m above sea-level. The following evidences seem also to confirm this assumption.

The Tatikawa Stage, including the conifer bed, is laid in a river terrace, and show the unconformity to the underlaid marine strata in Kwanto (4). The stage must have been formed, therefore during an elevated stage, which was followed by a subsidence, as may be inferred from the existence of the drowned valleys.

The age of elevation of the Japanese Islands deduced from the drowned valleys was first regarded to be the Upper Pliocene (Pre-Narita stage) which continued to the end of the Lower Pleistocene (Tama stage) ca. 720 m by YABE ('27, p. 433). But, the depth of the subsidence can be traced, so far as it is estimated from the drowned furrows in the chart of YABE and TAYAMA (fig. 10, 12, 13), down to ca. 1000 fathoms. Hence the land of Japan should have sunk down, towards the end of the Upper Pleistocene ca. 1500–2000 m, the conifer zone in the high altitude being brought down at the same time almost to the sea-level.

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(1) Prof. OGAWA asserts the descent of glacial tract to be about 700–800 m in Central Japan, which denotes far greater extension than ever estimated (19).

In my previous paper, I thought the age of the *Stegodon* Beds of Akasi to be just prior to the formation of the drowned valleys cited about. But as the age and the grade of the vertical shift are not the same, and moreover, as there occurred several lowland flora between these two ages, the land must have been lifted twice since the Upper Pliocene. In other words, there existed two continental ages, one in the Upper Pliocene and the other in the Upper Pleistocene.

#### B THE FLORAL DIFFERENCE IN THE TWO CONTINENTAL AGES

The Upper Pliocene of Japan was probably ca. 500–1000 m higher than at the present, forming a continuous block with the Asia Continent, as stated in my previous paper (13). In the Conifer Age the Islands had been connected again with the continent, as the waters within the Japanese Arc is shallower than 1000 m, except the middle part of Japan Sea, or much lesser than the height of the conifer forest at that age.

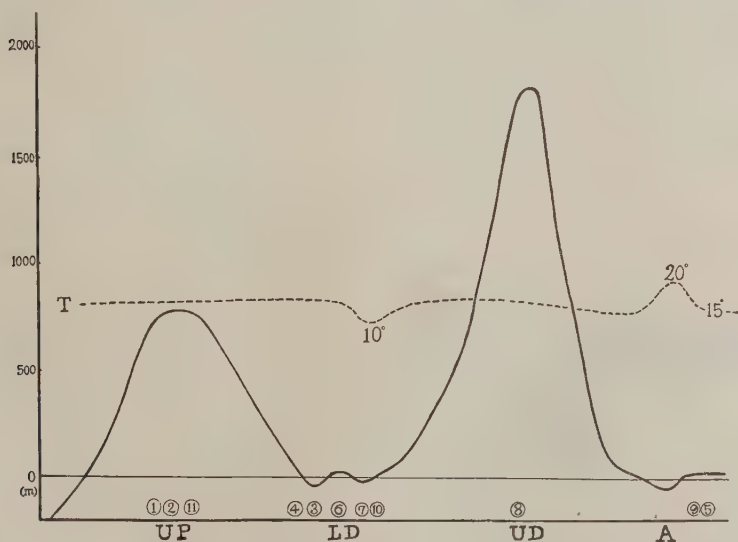


Fig. 16. Diagram showing the changes of sea-level, average air temperature at about 35° north latitude (temperature reduced to sea-level). Enclosed numerals show the approximate position of floral ages (see fig. 1).

- |   |   |
|---|---|
| 1. Fossil flora of Mogi.                          | 2. <i>Stegodon</i> Beds flora of Akasi. |
| 3. Pleistocene flora of Yamasiro.                 | 4. Pleistocene flora of Katada.         |
| 5. Peat bed flora of Azuti.                       | 6. Lignite bed flora of Simokurada.     |
| 7. Fossil flora of Yokohama.                      | 8. Conifer flora of Ekoda.              |
| 9. Neolithic flora of Ekoda.                      | 10. Fossil flora of Siobara.            |
| 11. <i>Juglans cinerea</i> bed flora of Hanamaki. |   |
| UP Upper Pliocene.                                | LD Lower Pleistocene.                   |
| UD Upper Pleistocene.                             | A Recent.                               |

Between these two elevated ages the sea-level seems, however, nearly the same or a little lower than now, because some marine remains were found as in the cases of the plant bed of Yamasiro(12) and the lignite bed of Simokurada. After the second subsidence the level is also alike, as seen from the coral remains a few meters above the sea-level in the Recent. The fluctuation of the sea-level, since the Upper Pliocene in Japan may be represented, therefore, graphically as in fig. 16.

The elevation of the land was in the former age ca. 700 m and in the latter ca. 1500–2000 m, or more than twice higher than the former. The floristic characters in these two ages are, however quite different; in the former it was arid, while in the latter it was humid. How then such a difference of climate should have been introduced?

The arid continental climate of the Upper Pliocene and the humid climate since then are not explainable by the assumption of the change of latitude as proposed by KÖPPEN and WEGENER ('24, p. 108, fig. 19). As has been stated by these authors the arid climate in the Upper Pliocene would be comparable with that of the Tropic of Cancer, so that the latitude should have been transformed ca. 15° southward. But the flora in that

age is, though more or less arid, not tropical, but temperate in its nature, hence the aridness must have been introduced by other circumstances.

So far as we can deduce from the actual climatic features of the present, the differences just mentioned must be attributed to the orographical condition in those ages. In the former ages the *Stegodon* Beds at Akasi and others must have been outlined by some mountain range, which acted as a barrier to the oceanic climate, while in the latter age the conifer bed had been exposed directly to the humid current, forming

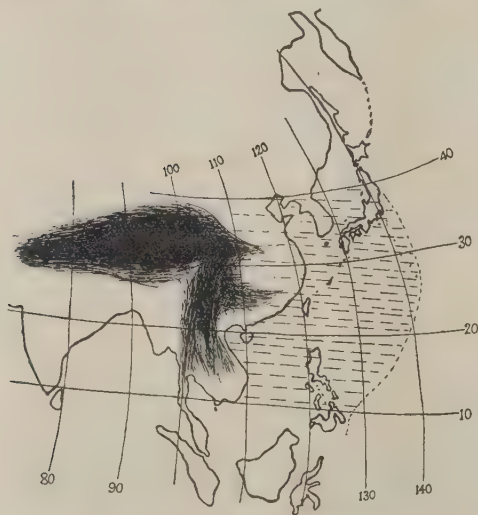


Fig. 17. The extension of the Oriental Asia in the early Tertiary. The dotted lines represent the hypothetical extension of the land or shallow sea.

ing a misty zone of the continent.

The outer barrier mentioned above may be considered as the eastern extension of the Asia Continent which has been drawn away, and sub-

sided during the elevation of Tethys Sea to the Himalayan Range in the middle age of the Tertiary. The eastern end of Tethys Sea must have been extended to the Bonnin Islands as shown by the nummulitic limestone. The existence of land or shallow sea in the early Tertiary may be roughly represented as fig. 17. The enormous folding of the Himalayan Range since the middle Tertiary may be regarded as a contraction of sial, not only from the south, but also from the east. At any rate the eastern margin of the Asia Continent in the Upper Pliocene must have been extended far eastward than at present.

That the Conifer Age was humid, is further supported by the fact, that the percentage of water or marsh plant has increased since the Lower Pleistocene, indicating that the climate in general got humid on account of some topographical changes.

## VI. Consideration on the composition of the recent flora

### A THE CHANGE OF THE CLIMATE SINCE THE UPPER PLIOCENE

The colder climate of the Upper Pliocene and the Conifer Age of the Upper Pleistocene in Japan may be explained by the upheaval of the land, without postulating the general lowering of temperature on the same sea-level as at present.

The climate of Yokohama and Siobara beds was considered by NATHORST(17) to be lower in temperature than today, and the latter bed was discussed afterward by ENDO(1) more in detail and regarded to be 5° colder than at present. The age should be younger than the ages of the Yamasiro flora, the lignite flora of Simokurada and the Katada flora of Kobiwako Series on account of the lesser number of the extinct species, but a little older than the Conifer Age by its constitution of the flora, and nearly contemporary with the Manzaki Substage(4), which is somewhat older than Tatikawa age with records of colder fauna reported by YOKOYAMA and others(29). The origin of cold climate is, however, in this case not explainable by the elevation of land, as the plant bed of Yokohama contains many remains of *Zostera marina* L. (Pl. IV A) and brackish water shells together with *Fagus crenata* BL., *Acer pictum* L. etc.

The age of the lower bluish clay bed of Ekoda of the Tokyo Stage, does not indicate, however, a cold climate. The plant remain is very scarce, but there was found one seed of *Fuirena tokyoensis* MIKI<sup>(1)</sup> n. sp. (Fig. 10 S) and a leaf fragment of *Raphiolepis*(?) both of which being

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(1) *Fuirena tokyoensis* MIKI n. sp. Achene compressed ovate, 2.5 mm high, 2 mm wide with 6 perianth, inner ones of which are branches at apex. The characteristic species of *Fuirena* is found in Africa (22).



allied to the southern element; the climate of the age should be similar to the present, as may be understood also by the fauna.

The climate of the Recent are recorded to be higher than today by the remains of coral at Noma<sup>(1)</sup> (33), Wakayama (18) and Tomie in Goto (28). Besides, the warmer indigenous molluscan remains are found in the Recent such as *Arca kiyonoi* by MAKIYAMA (10), though the corresponding floral remains are not yet found.

Thus the changes of temperature in geological ages since the Upper Pliocene in Japan may be graphically represented as in fig. 16.

### B THE EXTENSION OF THE EVERGREEN FOREST

In middle Japan there are both kind of trees: the evergreen and the temperate deciduous ones. The constitution of flora in the past is very different from the present one. The latter being especially rich in evergreen, not only in genera, but also in species. These evergreen elements seem to have been extended since the coral age. The climate of the neolithic flora of Ekoda and that of the peat flora of Azuti seem to be somewhat cooler as mentioned above; though the beds contain also many warmer elements existing together such as *Cornus brachypoda*, *Carpinus Tschonoskii* and *Aphananthe aspera* in both beds and *Quercus glauca* in the latter, all of which are common in Kinki District at present.

The present flora of Japan may be regarded, therefore, to be composed mainly of three relic elements, and the present one as shown in fig. 18 schematically: first the Arcto-Tertiary elements as *Magnolia*, *Alnus*

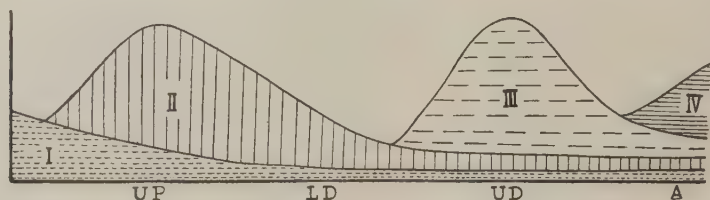


Fig. 18. Diagram showing the changes of the floral composition with the geological ages at about 35° north latitude in Japan.

- I Arcto-Tertiary element.
- II Arid continental element.
- III Boreal element in the Conifer Age.
- IV Evergreen subtropical element.
- UP Upper Pliocene.
- LD Lower Pleistocene.
- UD Upper Pleistocene.
- A Recent.

(1) The geological age of the coral at Noma was considered as the Pleistocene by YOKOYAMA (32) but revised by YABE and others to be the Recent.



etc., then the arid continental elements as *Gleditschia*, *Buxus* etc., further the boreal elements in the Conifer Age, and lastly the extension of evergreen forest of today.

## VII. Summary

1 The character and composition of plant remains in the *Juglans cinerea* bed of Hanamaki (Upper Pliocene) confirms the view already expressed. Namely that the climate of the Upper Pliocene was more arid continental than today.

2 The arid continental climate of the Upper Pliocene and the humid climate since then are not explainable by the changes of climatic zone as assumed by KÖPPEN and WEGENER, but it may be understood by the following assumption. In the Upper Pliocene there must have been existed some mountain range outlining the continent, which acted as a barrier to the oceanic climate, while in the latter age the Japanese Islands were exposed directly to the humid current. The outer barrier may be considered as the eastward extension of Asia Continent in the Upper Pliocene, which was contracted to the west during the enormous folding of the Himalayan Range.

3 The remains in the plant bed near Katada and the lignite bed of Simokurada, both belonging to the Lower Pleistocene, confirm also the view already expressed. That the extinction of some arid and open land species was caused by the general sinking of continental land, with the subsequent change in climate from the arid continental to the humid oceanic one.

4 The age of the conifer bed of Ekoda is estimated to be about 1500–2000 m higher lifting of the land than at present, because there exists a similar community at the height of 1500–2000 m at Mt. Sirane, Prov. Kai. The destitution of marine deposition of the age in Kwanto, the grade of drowned valleys and the continued existence of subtropical evergreen forest trees seem also to support the above statement.

5 The floral difference of these two continental ages is due to the circumstance, that in the Upper Pliocene the climate was arid and continental by the eastward extension of Asia Continent; while that of the Conifer Age in the Upper Pleistocene was humid, on account of high lifting of the land as well as by the topographical changes since the Lower Pleistocene.

6 The changes of the sea-level and the temperature since the Upper Pliocene were graphically represented in fig. 16.

7 The present flora of Japan is composed of four different elements: the Arcto-Tertiary elements, the arid continental elements, the boreal elements in the Conifer Age, and the extension of evergreen forest from the coral age till the present.

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## IX. Explanation of the plates III-IV

(The scale in each figure shows mm units)

### Pl. III. Plant remains in the conifer bed of Ekoda

- A-C Remains of *Larix Kaempferi* SARG.: A twigs and cones, B leaves, C seeds.  
 D Seed remains of *Taxus cuspidata* S. et Z.
- Ea Fa G J Remains of *Picea hondoensis* MAYR.: Ea seeds, Fa leaves, G male flower, J cones.
- Eb Fb H I Remains of *Picea bicolor* MAYR.: Eb seeds, Fb leaves, H twigs, I cones, Ia var. *reflexa* SHIRASAWA et KOYAMA.
- K-L Remains of *Pinus koraiensis* S. et Z.: K leaves, L seed.
- M-O Remains of *Tsuga diversifolia* MAST.: M twigs, N cones, O leaves.
- P-Q Remains of *Abies Mariesii* MAST.: P leaves, Q scale of cone (a) and seeds.  
 R Remains of *Alnus tinctoria* SARG.: a cones, b seed.  
 S Seed remains of *Potamogeton gramineus* L.  
 T Seed and fruit remains of *Carex rhynchophysa* C. A. MAY  
 U Remains *Drepanocladus exanulatus* (GUMB.) WARNST.

### Pl. IV. Plant remains from different localities

- A Remains of *Zostera marina* L. from the plant bed of Yokohama.
- B Remains of *Prunus Hawuscknechti* SCH. in the *Juglans cinerea* bed of Hanamaki.
- C Remains of *Phragmites communis* TRIN. the conifer bed of Ekoda.
- D Young fruit remains of *Aesculus turbinata* BL. var. *lineata* MIKI nov. from the neolithic bed of Ekoda.
- E Seed remains of *Pinus Armandi* FRANCH. in the lignite bed of Simokurada.
- F-G Remains of *Quercus crispula* BL.: F leaf from the conifer bed of Ekoda, G cupule from the neolithic bed of Ekoda.
- H Bract remain of *Tilia japonica* SIMK. in the conifer bed of Ekoda.
- I Remains of *Trapa bicerata* MIKI n. sp. in the lignite bed of Simokurada.
- J Remains of *Corylopsis epigyna* MIKI n. sp. in the plant bed near Katada.
- K Remains of *Carpinus erosa* BL. in the conifer bed of Ekoda.
- L Fruit remains of *Pyrus* cf. *Wilhelmi* SCH. in the *Juglans cinerea* bed of Hanamaki.
- M Nut remains of *Juglans Sieboldiana* MAX. in the neolithic bed of Ekoda: a var. *cordiformis* MAKINO.
- N Nut remains of *Juglans cinerea* L. from Hanamaki Pref. Iwate.

## X. Index of fossils

(Numerals show the number of figures)

- Abies firma*: 4 D  
*Abies Mariesii*: Pl. III P-Q, 10 D  
*Acer crataegifolium*: 5 N  
*Acer* cf. *Nordenskiöldi*: 2 I  
*Acer palmatum*: 6 L; 12 Nb  
*Acer pictum*: 12 Na  
*Actinostemma lobatum*: 14 V  
*Aesculus* sp.: 5 M  
*Aesculus turbinata*: 12 Rb c  
     var. *lineata* nov.: 12 Ra, Pl. IV D  
*Alnus japonica*: 2 J; 4 K; 6 I  
*Alnus tinctoria*: Pl. III R  
*Aphananthe aspera*: 12 E  
*Berberis longispinus*: 5 B  
*Berchemia racemosa*: 12 M; 14 L  
*Camellia japonica*: 5 K  
*Carex rhinchophylla*: Pl. III T  
*Carex* sp.: 12 We  
*Carpinus erosa*: Pl. IV K, 10 G  
*Carpinus Tschonoskii*: 12 D; 14 B  
*Cephalotaxus drupacea*: 4 A-B; 12 A  
*Ceratophyllum demersum*: 7 I  
*Chamaecyparis pisifera*: 4 G  
*Cicuta virosa*: 14 Q  
*Clerodendron tricolotum*: 12 V  
*Cocculus trilobus*: 14 F  
*Corylopsis epigyna* n. sp.: Pl. IV J, 5 C-D  
*Cornus brachypoda*: 12 P; 14 Gb  
*Cornus controversa*: 12 Q; 14 Ga  
*Corylus heterophylla*: 12 C  
*Cryptomeria japonica*: 4 C  
*Cyperus* sp.: 12 Wa  
*Drepanocladus exanulatus*: Pl. III U, 10 A-C  
*Elaeagnus*: 5 Q; 6 P-Q  
*Euryale ferox*: 7 H  
*Fagaria schiniifolia*: 6 M  
*Fagus Hayatae*: 4 Q-S; 6 F-H  
*Fagus crenata*: 10 I  
*Frangula crenata*: 14 R  
*Fuirena tokyoensis* n. sp.: 10 S  
*Gleditschia japonica*: 2 K; 5 F; 6 R(?)
- Ilex cornuta*: 5 J; 6 E  
*Iris laevigata*: 10 L; 14 X  
*Juglans cinerea*: Pl. IV N  
*Juglans Sieboldi*: Pl. IV M  
     var. *cordiformis*: Pl. IV Ma  
*Larix Kaempferi*: Pl. III A-C  
*Luzula* cf. *plumosa*: 10 O  
*Magnolia Kobus*: 2 H; 6 N; 12 J; 14 Db  
*Magnolia obovata*: 14 Da  
*Mallotus japonicus*: 12 H; 14 M  
*Myriophyllum* sp.: 7 D  
*Najas major*: 14 Y  
*Najas tenuicaulis*: 7 N-O  
*Nelumbo nucifera*: 7 F  
*Neolitsea aciculata*: 5 L  
*Naphar* cf. *akashiensis*: 7 G  
*Nuphar subintegerrimum*: 14 Hb  
*Nymphaea tetragona*: 14 Ha  
*Paliurus nipponicus*: 2 A; 5 E; 6 A  
*Phellodendron amurense*: 12 F; 14 Nb  
*Phragmites communis*: Pl. IV C, 10 P  
*Picea bicolor*: Pl. III Eb, Fb, I  
*Picea hondoensis*: Pl. III Ea, Fa, G, J  
*Pinus Armandi*: Pl. IV E, 6 C-D  
*Pinus densiflora*: —  
*Pinus koraiensis*: Pl. III K-L  
*Pinus Thunbergii*: 4 H-J  
*Polygonum Thunbergii*: 14 J  
*Potamogeton gramineus*: Pl. III S  
*Potamogeton Maackianus*: 7 K  
*Potamogeton malaianus*: 7 L  
*Potamogeton oxyphyllus*: 12 Y  
*Potamogeton pectinatus*: 7 J  
*Potamogeton perfoliatus*: 14 Zb  
*Prunus Haussknechti*: Pl. IV B, 2 B  
*Prunus* cf. *serrulata*: 12 I  
*Pteridium aquilinum*: 4 E  
*Pyrus* cf. *Wilhelmi*: Pl. IV L, 2 D-F  
*Quercus crispula*: Pl. IV F, G; 10 Q  
*Quercus gilva*: 4 N-P  
*Quercus glauca*: 14 C  
*Quercus serrata*: 12 B

- Rosa akashiensis*: 5 A  
*Rosa* sp.: 2 G  
*Rosa polyantha*: 14 I  
*Salix* cf. *Bakko*: 10 J  
*Salix* cf. *lasiogyne*: 4 M  
*Sapindus Mukorossi*: 12 O; 14 P  
*Sapium sebiferum* var. *pleistoceaca*: 5 I  
*Sasa* sp.: —  
*Staphylea Bumalda*: 12 S  
*Stephanandra incisa*: 12 K  
*Styrax japonicum*: 5 P; 12 T; 14 Ta  
*Styrax obassia*: 2 L; 6 O; 12 U; 14 Tb  
*Stuartia pseudocamellia*: 6 K  
*Sparganium* sp.: 7 M; 12 X; 14 Za  
*Spiraea* sp.: 10 H  
*Symplocos crataegoides*: 14 S  
*Taxus cuspidata*: Pl. III D; 10 E-F  
*Tilia japonica*: Pl. IV H; 10 K  
*Torreya nucifera*: 14 A  
*Trapa bicerata* n. sp.: Pl. IV I, 7 B  
*Trapa incisa*: 7 A  
*Trapa macropoda*: 5 H; 7 C  
*Trapella sinensis*: 7 E; 14 U  
*Tsuga diversifolia*: Pl. III M-O  
*Tsuga Sieboldii*: 4 F  
*Viscum coloratum*: 14 E  
*Vitis* sp.: 2 M; 5 O; 12 L; 14 O  
*Wistaria floribunda*: 5 G; 6 J; 14 K  
*Xanthoxylum piperitum*: 12 G; 14 Na  
*Zelkova Ungerii*: 4 L; 6 B  
*Zostera marina*: Pl. IV A

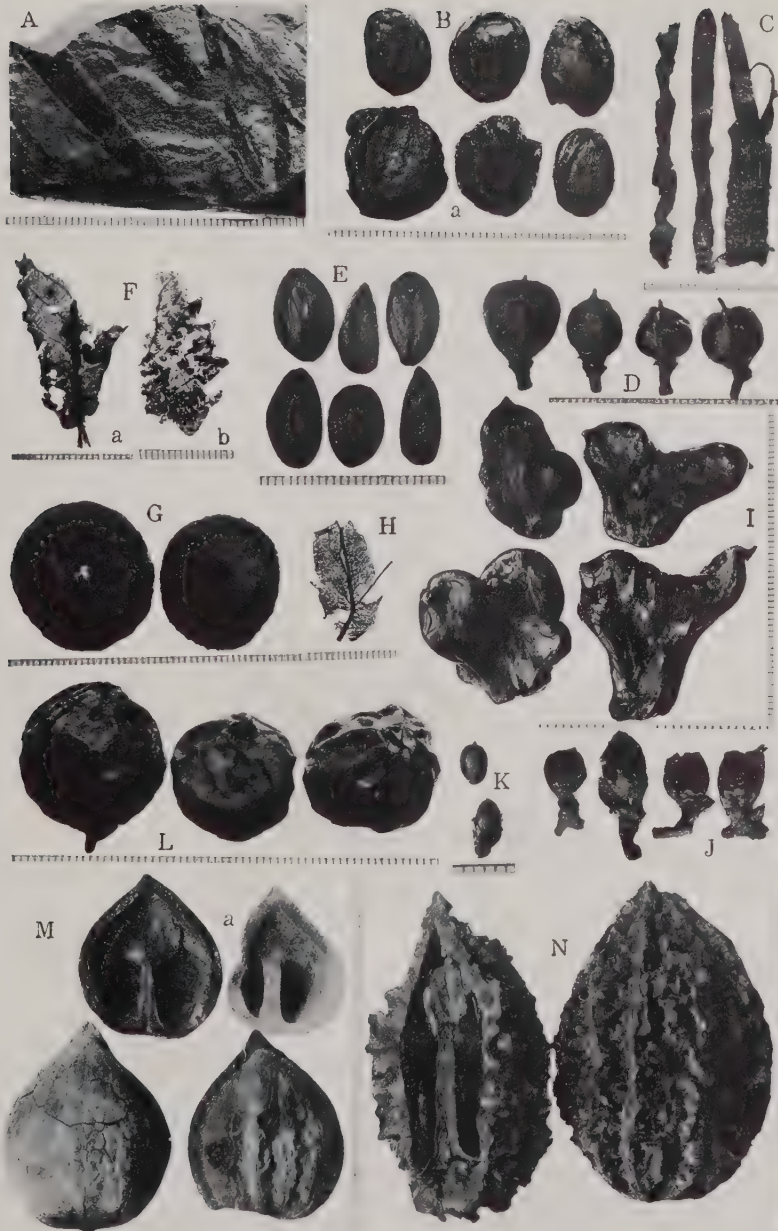








PLATE IV







# Untersuchungen über die Entwicklung der Myxomyceten auf faulenden Hölzern

Von Yoshikadzu EMOTO

Mit 3 Tabellen

(Eingegangen am 7. Februar 1938)

Studien über Myxomyceten wurden schon in älterer Zeit gemacht, doch die Substanzen, auf welchen diese Lebewesen wachsen, sind noch nicht genügend untersucht worden. Man schrieb allgemein, dass Schleimpilze an faulem Holz, abgefallenen Blättern, lebenden Stämmen sowie auch an Kräutern vorkommen. Sogar in näherer Beschreibung über die Art der Bäume galten bis jetzt z.B. nur „Koniferen“ usw., es ist also nötig, noch näher zu untersuchen, welche Art von Schleimpilzen an den verschiedenen Baumarten aufzuwachsen vermögen.

Es ist denkbar, dass wir bei natürlicher Fäulnis der Stümpfe und an abgestorbenen, umgefallenen Stämmen einen Unterschied in der Reaktion des verderbenden Holzes durch den auf dasselbe wirkenden Schimmel bemerken können; und zwar je mehr verschiedene Mikroorganismen zusammen wirken, desto komplizierter ist das Resultat.

Das Verhältnis zwischen den Myxomyceten und ihren auswachsenden Substanzen ist bis heute sehr wenig studiert worden und wir können hier nur BRANDZA's Arbeit<sup>(1)</sup> aufführen. BRANDZA legte im Spätherbst Stämme von Koniferen (*Pinus sylvestris*, *Abies pectinata*, *Picea exelsa*), Zweige von Populus (*P. pyramidalis*), Sägemehl und Strohschitzel auf drei ziemlich von einander entfernte Plätze in Bukarest, Rumänien, und prüfte das Resultat im nächsten Frühling. Er fand, dass 33 Arten und Varietäten, welche an diese Materialien wuchsen, nicht vom Schnee beschädigt waren, und dass im Zentrum der Stadt und auf staubigen Plätzen zweimal so viel Arten und Mengen vorhanden waren wie auf weniger staubigen Plätzen. Ferner fand er, dass die Myxomyceten Sägemehl und faulende Koniferenstämme bevorzugen.

Ich habe beim Sammeln von Schleimpilzen in 5 Jahren in Tokyo, Nikko, auf dem Fuji-Berg, in Kiso Gegend usw. besonders die Substanzen berücksichtigt, auf welchen Pilze wachsen. Selbstverständlich ist es sehr schwer, die faulenden Stämme zu beurteilen. In Tokyo wurden die bekannten Baumstämme an bestimmten Plätzen angehäuft; in anderen

(1) BRANDZA, M.: Sur l'apparition des myxomycètes dans la ville de Bucarest sur des substratums préparés d'avance. Ann. Soc. l'Univ. Jassy, **13**, (1924), 93.

Gegenden überliess ich es erfahrenen Leuten, z.B. in Nikko dem Gärtner des Botanischen Gartens der Kaiserlichen Universität und in Kiso und auf Fuji-Berg den Wächtern des Kaiserlichen Waldes die verfaulten Baumarten zu bestimmen.

Die untersuchten Materialien beziffern sich aus etwa 4000 und enthalten 76 Baumarten und 106 Myxomycetenarten. Die näheren Resultate

TABELLE 2. Faulende Bäume und die auf denen entwickelten Myxomyceten

Baumarten	Reaktion der fau- lenden Bäume (pH)	Zahl der entwi- ckelten Myxo- myceten	Baumarten	Reaktion der fau- lenden Bäume (pH)	Zahl der entwi- ckelten Myxo- myceten
<i>Quercus serrata</i>	4.4	49	<i>Kaunkhia floribunda</i>		
<i>Tsuga diversifolia</i>	4.6-5.6	43	var. <i>brachybotrytis</i>	5.5	5
<i>Betula Ermani</i> var.			<i>Lagerstroemia indica</i>	5.4-5.8	5
<i>communis</i>	4.2-5.6	33	<i>Acer tschonoskii</i>	5.4	4
<i>Abies firma</i>	5.2-5.6	25	<i>Aesculus turbinata</i>	5.6	4
<i>Fagus crenata</i>	5.6-6.0	25	<i>Castanea crenata</i>	5.2	4
<i>Abies Vitchii</i>	5.4	22	<i>Cercidiphyllum japo- nicum</i>	5.4-6.0	4
<i>Quercus crispula</i>	4.2-5.2	24	<i>Dentzia scabra</i> var.		
<i>Pinus Thunbergi</i>	4.8-5.6	19	<i>crenata</i>	5.6	4
<i>Abies homolepis</i>	5.4	18	<i>Meisteria rubicunda</i>	4.2	4
<i>Prunus Ssiori</i>	5.4-5.6	18	<i>Prunus yedoensis</i>	5.2	4
<i>Cryptomeria japonica</i>	5.4	17	<i>Sorbus aucuparia</i>	5.2-5.6	4
<i>Fagus japonica</i>	5.4-5.6	17	<i>Stewartia monadelph- a</i>	5.6	4
<i>Larix Kaempferi</i>	4.4-5.2	17	<i>Viburnum furcatum</i>	5.6	4
<i>Mallotus japonicus</i>	5.4	11	<i>Acanthopanax divari- catum</i>	5.6	3
<i>Shiia Sieboldi</i>	5.8	11	<i>Acer pictum</i> var. <i>typicum</i>		
<i>Prunus Grayana</i>	5.8	10	subv. <i>eupictum</i>	5.6	3
<i>Quercus acuta</i>	5.2-5.6	10	<i>Hydrangea scandens</i>	—	3
<i>Salix babylonica</i>	5.7	10	<i>Kalopanax ricinifolium</i>		
<i>Acer palmatum</i>	5.4	9	var. <i>typicum</i>	5.4-5.6	3
<i>Alnus japonica</i>	5.0-5.8	9	<i>Micromeles japonica</i>	5.4	3
<i>Fraxinus Sieboldiana</i>			<i>Musa Basjoo</i>	5.6	3
var. <i>serrata</i>	5.4	9	<i>Prunus triflora</i>	6.0	3
<i>Oryza sativa</i>	7.6	8	<i>Rhododendron degronia- num</i> f. <i>spontanum</i>	5.2	3
<i>Thuja Sandshii</i>	5.2-5.4	8	<i>Styrax japonicum</i>	5.4-5.8	3
<i>Acer japonicum</i> var.			<i>Thujaopsis dolabra</i>	5.2	3
<i>typicum</i>	4.6, 7.2	7	<i>Ulmus parvifolia</i>	5.4	3
<i>Carpinus carpinoides</i>	4.6	7	<i>Zelkova serrata</i>	5.6	3
<i>Ligustrum Iota</i> var.			<i>Chamaecyparis obtusa</i>	5.4-5.6	2
<i>angustifolium</i>	5.6	7	<i>Carpinus erosa</i>	5.4	2
<i>Morus bombycis</i>	5.4	7	<i>C. yedoensis</i>	5.2	2
<i>Picea jezoensis</i> var.			<i>Clethra barbinervis</i>	5.4	2
<i>hondoensis</i>	5.2	7	<i>Cornus controversa</i>	5.4	2
<i>Picea polita</i>	5.6	7	<i>Juglans Sieboldiana</i>	5.6	2
<i>Prunus incisa</i>	5.4	7	<i>Prunus nipponica</i>	5.2	2
<i>Sambucus Sieboldiana</i>			<i>Sasa nipponica</i>	5.4	2
var. <i>typica</i>	6.0	7	<i>Pinus parviflora</i>	5.4	1
<i>Alnus firma</i> var.			<i>Aphanthe aspera</i>	5.4	1
<i>Sieboldiana</i>	5.4	6	<i>Aralia elata</i>	7.2	1
<i>Betula Schmidtii</i>	4.8-5.4	6	<i>Evonimus Sieboldianus</i>	5.7	1
<i>Sasa senanensis</i>	5.4	6	<i>Malus Sieboldii</i>	5.4	1
<i>Acer palmatum</i> subsp.			<i>Parthenocissus Thun- bergii</i>	7.8	1
<i>Matsumurae</i>	5.4	5			
<i>Alnus alnobetula</i> var.					
<i>fruticosa</i>	4.4	5			
<i>Betula Maximowicziana</i>	5.2	5			





TABELLE 3. Myxomyceten und verfaulte Bäume

Myxomyceten	Reaktion der faulenden Bäume (pH)	Zahl der Baum- arten	Myxomyceten	Reaktion der faulenden Bäume (pH)	Zahl der Baum- arten
<i>Hemitrichia clavata</i>	4.2-6.0	34	<i>Tubifera ferruginosa</i>	4.2-5.6	6
<i>Arcyria denudata</i>	4.2-6.6	33	<i>Cribraria rufa</i>	4.6-5.6	5
<i>Physarum viride</i>	4.2-7.2	32	<i>Diderma effusum</i>	4.4-5.8	5
var. <i>aurantium</i>	4.4-6.0	6	<i>D. radiatum</i>	4.2-5.6	5
<i>Arcyria cinerea</i>	4.2-7.2	30	<i>Perichaena depressa</i>	5.4-6.0	5
var. <i>digitata</i>	4.2-5.2	3	<i>Stemonitis pallida</i>	4.2-5.6	5
<i>Ceratomyxa fruticulosa</i>	4.2-6.6	23	<i>Trichia persimilis</i>	4.2-6.0	5
var. <i>flexuosa</i>	4.2-5.8	12	<i>Clastoderma Debaryia-</i> <i>nium</i>	4.4-5.8	4
var. <i>porioides</i>	4.2-6.0	13	<i>Comatricha elegans</i>	4.4-5.4	4
<i>Physarum nutans</i>	4.2-5.7	22	<i>C. longa</i>	4.4-5.6	4
var. <i>robustum</i>	5.4-5.6	1	<i>Craterium leucocephalum</i>	4.6, 7.2	4
<i>Lycogala epidendrum</i>	4.2-6.0	22	<i>Cribraria purpurea</i>	4.4-5.6	4
var. <i>exiguum</i>	4.6-5.6	4	<i>C. tenella</i>	4.2-5.6	4
var. <i>tessellata</i>	4.6-5.6	1	<i>Diachea leucopoda</i>	5.4-5.7	4
<i>Stemonitis ferruginea</i>	4.2-6.0	12	<i>Dictydium cancellatum</i>	4.4-5.8	4
<i>S. splendens</i>	4.2-5.6	12	<i>Diderma hemisphericum</i>	4.4-7.6	4
<i>Cribraria intricata</i>	4.2-6.0	11	<i>Lamproderma columbi-</i> <i>nium</i>	4.4-5.7	4
var. <i>dictydioides</i>	4.2-5.4	5	<i>L. scintillans</i>	4.4-5.7	4
<i>Trichia decipiens</i>	4.2-5.6	11	<i>Physarum tenerum</i>	4.6-7.2	4
<i>Fuligo septica</i>	4.2-5.8	10	<i>Trichia floriformis</i>	4.2-6.0	4
<i>Cribraria microcarpa</i>	4.2-5.6	9	<i>Arcyria incarnata</i>	4.4-5.7	3
<i>Physarum Newtoni</i>	4.2-5.6	9	<i>A. pomiformis</i>	5.6-6.0	3
<i>Reticularia Lycoperdon</i>	4.4-6.0	9	<i>Badhamia affinis</i>	4.4-5.6	3
<i>Stemonitis fusca</i>	4.2-6.0	9	<i>Comatricha pulchella</i>	4.2-5.7	3
var. <i>rufescens</i>	4.2-5.6	2	<i>Craterium minutum</i>	4.4-5.8	3
<i>Arcyria nutans</i>	4.2-5.8	8	<i>Cribraria violacea</i>	4.4-5.6	3
<i>Cribraria vulgaris</i>	4.4-5.6	8	<i>Dictydium aethalium plum-</i> <i>beum</i> var. <i>cinnabarinum</i>	4.4-6.6	3
var. <i>aurantium</i>	4.2-6.0	13	<i>Diderma ochraceum</i>	4.6-5.6	3
<i>Didymium melanospermum</i>	5.2-7.6	8	<i>Hemitrichia serpulula</i>	4.2-7.6	3
<i>D. nigripes</i>	4.2-7.6	8	<i>Perichaena chrysosperma</i>	5.2-6.0	3
var. <i>xanthopus</i>	5.6, 7.6	2	<i>Physarum didermoides</i> var. <i>lividum</i>	5.5-7.8	3
<i>Trichia favoginea</i>	4.2-5.6	8	<i>P. penetrans</i>	4.2-6.0	3
<i>Comatricha nigra</i>	4.4-5.8	7	<i>Trichia affinis</i>	4.4-6.6	3
<i>C. typhoides</i>	4.2-7.2	6	<i>T. erecta</i>	4.4-5.6	3
<i>Lamproderma arcyrionema</i>	4.2-6.0	6	<i>Comatricha laxa</i>	5.2-5.6	2
<i>Leocarpus fragilis</i>	4.6-6.0	6	<i>Cribraria ferruginea</i>	4.4-5.4	2
<i>Trichia Botrytis</i>	4.2-5.6	6			



TABELLE 3 (Fortsetzung)

Myxomyceten	Reaktion der faulenden Bäume (pH)	Zahl der Baum- arten	Myxomyceten	Reaktion der faulenden Bäume (pH)	Zahl der Baum- arten
<i>C. macrocarpa</i>	5.2-5.4	2	<i>P. roseum</i>	4.6-5.6	2
<i>Diachea cerifera</i>	4.6-5.6	2	<i>P. serpula</i>	5.4-7.6	2
<i>Diderma spumarioides</i>	5.4-5.6	2	<i>P. sinuosum</i>	5.6-6.0	2
<i>D. testaceum</i>	4.6-5.6	2	<i>Stemonitis flavogenita</i>	4.2-5.6	2
<i>Didymium clavus</i>	5.5-5.6	2	<i>Trichia varia</i>	5.6-6.0	2
<i>D. difforme</i>	5.2-5.7	2	<i>Tubifera stipitata</i>	4.4-5.6	2
<i>D. leoninum</i>	4.5-7.2	2	<i>Amurochaete cribrosa</i>	4.8-5.6	1
<i>D. squamulosum</i>	7.6	2	<i>Arcyria Oestdtii</i>	4.6-5.6	1
<i>Enerthenema papillatum</i>	5.2-5.6	2	<i>Badhamia nitens</i>	4.8-5.6	1
<i>Enteridium Roseanum</i>	4.2-5.6	2	<i>B. rubiginosa</i> var. <i>dictyospora</i>	5.4	1
<i>E. Yabeanum</i>	4.6-5.6	2	<i>B. utricularis</i>	5.6-6.0	1
<i>Eroinema aureum</i>	5.2-5.4	2	<i>Barbeyella minitissima</i>	5.6	1
<i>Hemitrichia vesparium</i>	4.2-5.6	2	<i>Colloderma oculatum</i>	4.4	1
<i>Mucilago spongiosa</i>	5.4	2	<i>Cribraria argillacea</i>	4.6-5.6	1
<i>Physarella oblonga</i>	5.4	2	<i>C. minutissima</i>	4.6-5.6	1
<i>Physarum compressum</i>	5.6-7.6	2	<i>Diderma arboretum</i>	4.4	1
<i>P. globuliferum</i>	4.4-5.6	2	<i>D. floriforme</i>	4.6	1
<i>P. melleum</i>	4.4-5.7	2	<i>Lepidoderma tigrinum</i>	5.6	1
<i>P. mutabile</i>	4.4-5.7	2	<i>Licea flexuosa</i>	5.2-5.6	1
<i>P. nucleatum</i>	4.8-6.0	2	<i>Physarum lateritium</i>	5.7	1
<i>P. psittasinum</i> var. <i>fulvum</i>	4.4-7.2	2	<i>P. maydis</i>	4.4	1
<i>P. rigidum</i>	4.4-5.4	2	<i>P. sulphureum</i>	4.4-5.6	1

können wir in der Tabelle 1 durchsehen. Diese Resultate ergaben, dass die Reaktion der faulenden Bäume meistens pH = 4.2-5.8 beträgt; es tritt gelegentlich auch pH = 7.0 auf oder sogar alkalische Reaktion, wenn auch sehr wenig. Aus diesem Grunde können wir annehmen, dass Plasmodien, wie schon früher kurz mitgeteilt worden ist, sich in obenerwähnter saurer Reaktion sehr günstig entwickeln, und dass auch die keimenden Sporen gleiche Bedingungen nötig haben. Diese Tatsache stimmt gut mit dem Resultat von SMART<sup>(1)</sup> überein, welcher die Sporenkeimung von 70 Myxomycetenarten an verdünnten Dekokten von Erbsen, gefallenden Blättern, faulendem Stamm der *Pinus*- und *Salix*-Arten durchgeführt hat; d.h. er fand im allgemeinen pH = 4.0-8.0, und im besonderen eine optimale Reaktion bei pH = 4.5-7.0.

(1) SMART, R. F.: Influence of certain external factors on spore germination in the myxomycetes. Amer. Journ. Bot., **24**, (1937), 145.

Aus der Tabellen 2 und 3 können wir ersehen, dass die Myxomyceten am faulenden Holze von *Quercus serrata* am zahlreichsten sind, und zwar 49 Arten. An nächster Stelle stehen 43 Arten, welche sich am faulenden Holz von *Tsuga diversifolia* entwickeln. Sodann 33 Arten an *Betula Ermanni* var. *communis*, 25 Arten an *Abies firma*, 24 Arten an *Quercus crispula* und *Fagus crenata*, 22 Arten an *Abies Veitchii* usw. Auf der anderen Seite beobachten wir, dass *Hemitrichia clavata* sich am häufigsten an verschiedenen Baumarten (34) entwickelt, ebenso wachsen *Arcyria denudata*, *Physarum viride*, *Arcyria cinerea*, *Ceratiomyxa fruticulosa*, *Physarum nutans*, *Lycogala epidendrum* häufiger an verschiedenen faulenden Bäume. Diese Tatsache lässt uns vermuten, dass derartige Myxomyceten in Japan häufig zu finden sind.

Zum Schluss danke ich der kaiserlichen Akademie herzlichst, welche mir mit ihrer Stiftung zu grösstem Teil dieser Studien verholfen hat.

BIOLOGISCHE ABTEILUNG DER ADELSSCHULE,  
MEJIRO, TOKYO.

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## Abstracts Nos. 138-331

(Referring mostly to the principal papers in Botany and allied subjects  
which have appeared in Japan during January-June 1937)

**138. Non-disjunction of the meiotic chromosomes of *Rhoeo discolor*.** (Japanese with English résumé). Toshio AKEMINE. (Japan. Jour. Gen. **13**, 1937, 31-36, 8 text-figs.).

During the meiosis in the PMCs of *Rhoeo discolor* twelve chromosomes conjugate end-to-end to form a ring or one or several chains. The author could observe very often the non-disjunction of either adjacent chromosomes in a ring or long chain or that of adjacent kinetochores connected by arms (short or long, especially in the former case). For instance, he could count among 100 PMCs more than 30 cases of non-disjunction of adjacent chromosomes. The necessary result of such non-disjunction is that some pollen tetrads receive less than one genome, which will degenerate soon after their formation.

**139. Lokalisation der lichtempfindlichen Zone von Keimorganen bei *Avena sativa* L.** (Mit japan. Zfg.). Tōru ARAKI und Hideo HAMADA. (Bot. Mag. Tôkyô **51**, 1937, 498-504, 2 Taf., 621-622).

Für die Untersuchung wurden die Haferkeimlingen benutzt, welche bei 30°C im dunkeln Kasten aufgestellt wurden und dafür war die SACHSSsche Nährlösung im Gebrauch. Die Experimente begannen erst zur Zeit, wo das Mesokotyl resp. die Koleoptyle des Keimlings ungefähr 6 mm erreicht hat. Die Experimente bestanden darin, dass das Mesokotyl und die Koleoptyle während 15 Min. mit 50 MK belichtet wurden, und zwar dabei wurde mittelst einer eigentümlichen Einrichtung deren Ober-, Mittel- und Unterteil getrennt belichtet (Punktierbelichtung). Die Wirkung solcher Belichtung auf das Wachstum von beiden Organen sind wie folgt:

I. Koleoptyle belichtet: Dabei erleidet das Mesokotyl die grösste Hemmung des Wachstums, besonders in seinem Unterteil. Keine namhafte Wachstumshemmung der Koleoptyle ist zu beobachten. Bei den Primärblättern findet die Wachstumshemmung durch die Oberteilbelichtung statt, dagegen die Wachstumsförderung durch die Mittel- oder Unterteilbelichtung.

II. Mesokotyl belichtet: Mesokotyl stark in seinem Wachstum gehemmt, besonders durch die Oberteilbelichtung. Bei der Koleoptyle ist die Reaktion nicht immer dieselbe, da bald die Hemmung, bald die Förderung des Wachstums geschieht. Bei den Primärblättern findet die Wachstumsbeschleunigung in der Regel statt.

**140. Anzia-Arten aus Japan mit besonderer Berücksichtigung der chemischen Bestandteile.** (Mit japan. Zfg.). Yasuhiko ASAHINA. (Jour. Japan. Bot. **13**, 1937, 219-226, 5 Textabb.).

Bei der Artbegrenzung der Flechten mittels ihrem Chemismus sind zwei folgende Sätze zu berücksichtigen, nämlich, 1. obgleich zwei Arten morphologisch nah verwandt sind, sind sie als verschieden zu betrachten, wenn sie verschiedene chemische Bestandteile enthalten und 2. die Menge von zwei oder mehreren chemischen Bestandteilen einer Flechte kann recht stark variieren, ja sogar in ein und derselben Art. Unter Berücksichtigung von diesen zwei Sätzen hat der Verf. die folgenden japanischen Anziaarten unterscheiden können, wofür ein Bestimmungsschlüssel angegeben ist, nämlich *A. japonica*, *ornata*, *stenophylla* und *formosana*.

**141. Lichenologische Notizen IX.** (Mit japan. Zfg.). Yasuhiko ASAHINA. (Jour. Japan. Bot. **13**, 1937, 315-321, 6 Textabb.).

Die folgenden Flechten sind beschrieben; *Thamnolia subvermicularis* sp. nov., *Trypetheliopsis* gen. nov. mit *T. boninensis* sp. nov.

**142. Studies on the leaf movement of *Aldrovanda vesiculosa* L. III. Reaction time in relation to temperature.** Joji ASHIDA. (Bot. Mag. Tōkyō **51**, SHIBATA Commem. No., 1937, 323-331, 5 text-figs.).

Using cinematographic apparatus the reaction time of *Aldrovanda* leaves is measured at 10°, 15°, 25°, 30° and 39°, when stimulated with low voltage direct current, and at 10°, 15°, 20°, 25° and 40°, when stimulated with higher voltage. The number of leaves observed is nearly 2000 in all. The reaction time varies according to the temperature and the intensity of the stimulus. But as the variation is also very large from leaf to leaf, the results are shown in frequency-distribution diagrams, the class interval chosen being 15 % of the mean reaction time in each case. In the case of the weak stimulation, the frequency-distribution diagram under each temperature is remarkably skewed near to the shortest reaction time, two modes being apparent in each diagram. It is shown that the bimodality is not due to mixing up of the data of old and young leaves. The position of the first of the two modes, as well as the position of the second, change with the temperature in accordance with the BĚLEHRÁDEK formula. It is supposed that the first mode is due to leaves in which the reaction is induced by the direct stimulation of cells of the motile zones themselves, while the second mode is due to leaves in which the reaction appears after the excitation is conducted from the sensitive hairs. In the case of the strong stimulation, almost all the leaves react very quickly, constituting only one mode in the diagram. Almost all the leaves are supposed in this case to have been sufficiently stimulated in the cells of the motile zones.

Author.

**143. On a strange virosis of the mulberry tree.** (Japanese with English résumé). Yasutaro ENDŌ and Tsuneo KURASAWA. (Bull. Seric. and Silk Indus. **9**, 1937, 115-132, 4 pls. and 6 text-figs.).

A virus disease of the mulberry tree which is now prevalent in various parts of Japan breaks out externally in various manners: mottling, thickening of mesophyll, clearing of leaf-veins, intervenal clearing, production of enations or leaf-like outgrowths on the under surface of leaves, complete suppression of the lamina causing filiform leaves, clustering of leaves at the shoot apex. Such leaves are naturally not suitable for the feeding of silkworms. The final result of this disease is the stoppage of the growth of trees and their death. No microorganisms are observable in the tissues of the diseased, but the so-called X-bodies are seen in various cells.

**144. Über die Reihe 2, 5, 7, 12... in der schraubigen Blattstellung und die mathematische Betrachtung verschiedener Zahlenreihensysteme.** (Mit japan. Zfg.). Tetsuo FUJITA. (Bot. Mag. Tōkyō **51**, 1937, 480-489, 2 Taf., 619-620).

Der Verf. fasst die Resultate seiner Beobachtungen, welche die in vorliegendem Titel genannten Tatsache betrifft, wie folgt zusammen (nach dem eigenen Worte des Verfs.):

Bei *Cephalotaxus drupacea* S. et Z. wurde die Nebenreihe 2, 5, 7, 12... gefunden und die Divergenz statistisch gemessen. Sie folgt nicht dem Wert der SCHIMPER-BRAUNschen Divergenz, sondern dem Limitwert  $151^{\circ}8'6''$ .

Die Divergenz  $\alpha$  und der Quotient  $\beta/\alpha$ , worin  $\beta$  den Restwinkel darstellt, stehen im engeren Zusammenhang mit der göttlichen Proportion  $\chi$ .



Bei den ersten Reihensystemen wie  $1, a, 1+a, 1+2a, \dots$ , die im Pflanzenreich am häufigsten vorkommen, verhält sich der Quotient  $\beta/\alpha$  und die Divergenz  $\alpha$  mit  $\chi$  wie folgt:  $\frac{\beta}{\alpha} = \chi, \alpha = \frac{1}{a+\chi} \cdot 360^\circ$  ( $a \geq 1$ ) und je kleiner  $a$  ist, desto häufiger tritt die Reihe auf. Deshalb kommt die Hauptreihe, in der  $a = 1$  oder  $2$  ist, am häufigsten vor.

Bei den zweiten Reihensystemen wie  $p, ap+1, (a+1)p+1, \dots$  verhalten sich  $\frac{\beta}{\alpha} = \frac{1}{a+\chi}$  und  $\alpha = \frac{1}{p + \frac{1}{a+\chi}} \cdot 360^\circ$  ( $p \geq 2, a \geq 2$ ) und unter diesen die Reihen  $2, 5, 7, \dots, 2, 7, 9, \dots, 2, 9, 11, \dots$  bekannt.

Bei den dritten Systemen wie  $p, ap-1, (1+a)p-1, \dots$ , wobei

$$\frac{\beta}{\alpha} = \frac{(a-1)+\chi}{a+\chi}, \alpha = \frac{1}{(p-1) + \frac{(a-1)+\chi}{a+\chi}} \cdot 360^\circ$$

( $p > 3, a > 3$ ) sind, sind bisher die Reihen  $3, 8, 11, \dots, 3, 14, 17, \dots$  bekannt.

**145. Anomalous secondary growth in *Bauhinia japonica* MAXIM.** Tsugio HANDA. (Japan. Jour. Bot. **9**, 1937, 37-53, 1 pl. and 10 text-figs.).

**146. Observationes ad plantas Asiae Orientalis (XIII).** (With Japan. résumé). Hiroshi HARA. (Jour. Japan. Bot. **13**, 1937, 171-180, 2 text-figs.).

The following new species are described: *Pulsatilla sachalinensis*, *Alchemilla japonica*, *Diplomorpha capitellata*.

**147. Preliminary report of the flora of Southern Hidaka, Hokkaido (Yezo) XVII-XX.** (With Japan. résumé). Hiroshi HARA. (Bot. Mag. Tôkyô **51**, 1937, 14-21 with 1 text-fig., 32-33, 48-59, 78, 87-93, 116, 142-149 with 1 text-fig., 175).

Among others *Swertia yezo-alpina* with its diagnosis is contained in this paper.

**148. Two new genera of Saxifragaceae in Japan.** Hiroshi HARA. (Bot. Mag. Tôkyô **51**, 1937, 250-253, 4 text-figs., 399-400).

*Peltoboykinia* and *Neoboykinia* are new genera. The first contains two new species, *B. tellimondes* and *Watanabei*, and the second one, *N. lycopotonifolia*.

**149. On some experiments in raising a nicotine-free tobacco plant.** (Japanese with English résumé). Hiroshi HASEGAWA. (Bot. Mag. Tôkyô **51**, 1937, 306-316, 3 text-figs.).

Although some experiments of grafting have hitherto been performed in order to get the nicotine-free tobacco leaves, the observations were made only during a very limited time after the grafting operation. The author's observations have however been extended over seven months. When the grafting tobacco (graft) is made, the nicotine disappears entirely from the tobacco leaves, though even the graft is growing vigorously. The nicotine-free tobacco leaves have proved to be mild and sweet on smoking. In the grafting tobacco (graft), etc. the nicotine soon appears in the leaves of the graft, and they are highly stimulative with a perceptible odour of nicotine.

**150. Über die Blütentemperatur von *Nelumbo nucifera* GAERTN.** (Japanisch). Isao HATAKEYAMA. (Bot. & Zool. **5**, 1937, 463-468, 11 Textabb.).

Die Wärmeentwicklung beim Blühen von *Nelumbo nucifera* wurde schon früher studiert, und zwar mit Hilfe des gewöhnlichen Quecksilberthermometers. Indem aber

das Quecksilberggefäß des letzteren, sowohl in seinem Volum als in seiner Wärmekapazität ziemlich gross ist, wird er zum Wärmemessen einzelner Blütenteile nicht besonders geeignet sein, woher der Verf. bei seiner gleichartigen Untersuchung eine galvanometrische Messung ausgeführt hat, und zwar mit Hilfe eines aus Konstantan und Kupfer hergestellten Thermoelementes. Die allgemeinen Resultate von solchen Versuchen sind wie folgt.

Die Temperatur des Blütenstieles stimmt im ganzen mit derselben der Umgebung fast überein. Einwärts der Blütenhülle erhöht sich sie allmählich bis zur inneren Höhle der Blüten. Bei der Blütenknospe, welche nachher nach drei Tagen geöffnet zu haben beobachtet wurde, hat der schmallange Teil des Blütenbodens, welchen der Verf. das Gynophor nennt, eine Temperatur  $+5^{\circ}\text{C}$  angezeigt ( $+$  hier bedeutet, "über die Temperatur der umgebenden Luft"), während in den Blüten, welche neulich geöffnet haben, beobachtet man bei einer 3 cm langen Gynophor die höchste Temperatur, nämlich  $6^{\circ}\text{C}$ . Bei den älteren Blüten, wobei schon alle Hüllblätter abgefallen sind und doch die Staubblätter noch verbleiben, ist die Temperatur zu  $+0.5^{\circ}$  abgestiegen und bei denselben, wobei die Früchte schon halbgereift sind, ist keine besondere Wärmeentwicklung mehr nachzuweisen. Das "Gynophor", und besonders sein mittlerer Teil, ist also die Hauptquelle der Blütenwärme aufzufassen.

**151. Studien über Anthocyane. II. Über die Farbstoffe aus den roten Herbstblättern von einigen *Acer*-Arten.** Shizuo HATTORI und Kôzô HAYASHI. (Acta Phytochim. **10**, 1937, 129-138, 5 Textabb.). (Das gleiche in japanisch m. deutsch. Zfg. in Bot. Mag. Tôkyô **51**, 1937, 366-372, 3 Textabb.).

Es wurde gezeigt, dass die herbstliche Rotfärbung von Blättern bei *Acer*-Arten wirklich von Anthocyanen verursacht wird, wie früher ohne sichere chemische Beweisführung vermutet worden ist. Bearbeitet wurden zwei Arten, nämlich *Acer circumbotatum* MAXIM. und *A. ornatum* CARR. var *Matsumurae* NAKAI, und das Anthocyan konnte in beiden Fällen mit dem Chrysanthemmin, Cyanidin-3-glucosid, identifiziert werden. Die isolierte, zu chemischer Untersuchung zur Verfügung gestandene Menge war natürlich sehr klein, also ca. 50 mg aus 1757 g Blättern (frisch) der ersten Pflanze und ca. 10 mg. aus 247 g von der letzteren. Als Vergleichsobjekt wird das Chrysanthemmin aus den dunkelroten Blüten einer Abart von *Chrysanthemum sinense* SABINE isoliert.

Neben dem Chrysanthemmin und zwar in grösserer Menge kommt auch eine rotbraune amorphe Substanz vor, welche keine Neigung zur Krystallisation hat, in Wasser und Äther unlöslich, aber in Alkoholen mit brauner Farbe löslich ist. Diese Substanz stimmt in ihren Eigenschaften mit den Phlobaphenen überein.

Das Chrysanthemmin krystallisierte in feinen, linsenförmigen, dunkelroten Täfelchen mit einem prachtvollen Goldglanz. Lufttrocken zog sich das Präparat bei  $222^{\circ}$  plötzlich zusammen. Verff.

**152. Über das Quercetinglukosid aus *Trifolium*-Blüten.** Shizuo HATTORI, Masao HASEGAWA und Kôzô HAYASHI. (Acta Phytochem. **10**, 1937, 147-153).

Als die glykosidischen Inhaltsstoffe der Blüten vom gemeinen Weissklee, *Trifolium repens* LINNAEUS hat T. NAKAOKI 1933 zwei Glykoside, „Trifoliin“ und „Isotrifoliin“ beschrieben, welche zu einander sehr ähnlich sind, sodass ihre Selbständigkeit von den Verfassern bezweifelt wurde. Die Verfasser haben die Bearbeitung von neuem vorgenommen. Es bestätigte sich dann, dass das sogenannte „Isotrifoliin“ nichts anderes als das altbekannte Isoquercitrin ist, und weiter dass das „Trifoliin“ etwas unreines Isoquercitrin ist.

Das Isoquercitrin wurde aus Pflanzenmaterial durch Extraktion mit heissem 80% Alkohol erhalten und des weiteren auf zweierlei Wegen, nämlich einmal durch Einengen des alkoholischen Extraktes und durch erschöpfendes Ausschütteln des Rückstandes mit Essigester, und andermal durch Versetzen des etwas eingengten Alkoholextrakts mit Bleiacetats, Zersetzen des Bleisalzes mit Schwefelwasserstoff, Aufnehmen mit Essigester. Der Schmelzpunkt des Isoquercitrins ist je nach der Art des Lösungsmittels veränderlich; also 235–236°, 243° bzw. 248°.

Der Krystallwassergehalt ist genau ermittelt. Eine Stunde nach dem Abfiltrieren enthalten die Krystalle 4 Mol H<sub>2</sub>O gebunden, aber nach 5 Stunden geben 1/2 Mol. davon, und nach 50 Stunden weitere 2½ Mol. ab, um dann in die stabile Form überzugehen. Die völlig getrocknete Substanz zieht an der Luft wieder Wasser zu 1½ Mol. Verff.

**153. Studien über Anthocyane III. Über den Farbstoff aus den scharlachroten Blüten von *Lycoris radiata*.** Kôzô HAYASHI. (Acta Phytochim. 10, 1937, 139–146, 3 Textabb.)

Verfasser berichtet über den roten Farbstoff aus den scharlachroten Blütenhüllen von *Lycoris radiata* HERB., einer Amaryllidacee, welche in diesem Lande weit verbreitet ist. Die frischen, von grünen Teilen befreiten Blüten wurden mit 1 % methanolischer Salzsäure kalt ausgezogen, aus welchem Extrakt der färbende Bestandteil mit Bleiacetat als Bleiverbindung ausgefällt wurde. Diese wurde mit Salzsäure zerlegt und der Farbstoff in Pikrat übergeführt. Das gereinigte Pikrat wurde dann in Chlorid verwandelt und in diesem Zustande mit dem Chrysanthemin identifiziert. HATTORI.

**154. Notes on the abnormal *Osmunda japonica* THUNB.** (Japanese). Minoru HAYASHI. (Jour. Japan. Bot. 13, 1937, 448–454, 4 text-fig.-groups).

*Osmunda japonica* produces in spring both sterile and fertile leaves. Leaves which are partly fertile and partly sterile are often found. For instance, some leaves are fertile in their upper and sterile in their lower part, while in some other ones this relation is reversed. The proportion of fertile and sterile part in one leaf is various. The author has collected a large number of such leaves, and basing on their precise observation he thinks that there may be two possibilities of the mode of such abnormal formation, viz. that either the incipient sterile leaf will change partly into the fertile leaf during its development or just the reverse will take place during the development of the latter.

**155. The haustorium of some powdery mildews.** (Japanese with English résumé). Kôzi HIRATA. (Ann. Phytopathol. Soc. Japan 6, 1937, 319–334, 14 text-figs.).

For the materials of observation *Erysiphe cichoracearum*, *E. polygoni*, and *E. graminis* were taken. It is well known that no conidia placed in a water-drop on the cover-glass do germinate well. The author has used for the substratum of the germination the epidermis stripped off from the onion bulb or leaf which is treated at first with alcohol, washed with water and then dried, where the conidia germination is very vigorous, surpassing in this respect even the epidermis of the host plant itself. Since in this case the epidermis is treated with alcohol and thus all soluble substances therein must have been dissolved away it is clear that for the production of infection hyphae no chemical stimulating action of certain substances excreted by the host is not at all necessary.

The infection hyphae produce the haustoria which are ellipsoidal in shape. At their both ends a certain number of processes are developed, which are sometimes straight (*Erysiphe graminis*), sometimes convolute (*E. cichoracearum*). Though the

young haustorium is in direct contact with the protoplasm of the host cell, a vesicle is formed soon around it, whose derivation is not yet exactly known. It is turgid, stains with colouring agents, and swells up intensely by various reagents. In old haustoria their processes become indistinct, the vesicle loses its turgidity, and at last the outline of the haustorium becomes invisible.

**156. Miscellaneous notes on the East-Asiatic Uredinales with special reference to the Japanese species (I).** Naohide HIRATSUKA. (Jour. Japan. Bot. **13**, 1937, 244-251, 3 text-figs.).

The following are described among others: *Coreopucciniella Idei*, *Chrysomyxa Tsugae*, *Cerotelium Hashiokai*, *Puccinia Abei*.

**157. Gymnosporangium of Japan V.** (With Japan. résumé). Naohide HIRATSUKA. (Bot. Maz. Tôkyô **51**, 1937, 1-8, 31-32).

This part contains a key for the identification of the Japanese *Gymnosporangium* species and a list of literature cited by the author.

**158. Uredinales collected in Formosa VI.** Naohide HIRATSUKA. (Bot. Mag. Tôkyô **51**, 1937, 41-47).

*Uredinopsis* (2), *Milesina* (5), *Melampsosoridium*, *Pucciniastrum* (2), *Melampsola*, *Phakopsora*, *Cronartium* (2), *Coleosporium*, *Hemileia*, *Hamasporea* (2), *Phragmidium* (2), *Angiopsora*, *Uromyces* (2), *Puccinia* (8), *Aecidium* (9), *Uredo* (6) *Coleosporium* are enumerated. (The figures within the brackets denote the number of species; one species is meant, when no figures are given).

**159. Occurrence of inclusive bodies in the guard-cells of the stomata of mosaic tobacco plants.** (With Japan. résumé). Shigekatsu HIRAYAMA and Akira YUASA. (Ann. Phytopathol. Soc. Japan **6**, 1937, 305-306, 2 text-figs.).

Formerly (cf. this Jour. **8**, (44), No. 177) the authors have announced the fact that they have observed the X-bodies in the guard-cells of stomata of mosaic-diseased tobacco plants. Recently (1936) SHEFFIELD has stated that he could find no such abnormal cell-inclusions in mosaic-diseased tobacco leaves. The authors have repeated their former observations and could confirm them perfectly. Further, they have discovered the fact that the abnormal cell-inclusions just indicated are gradually dissolved away by acetic acid. The failure SHEFFIELD's to find them is evidently due to his method of preparation, which consists in fixing the materials by CARNOY's fluid and staining according to FEULGEN's method, combined with the treatment by orange.

**160. Preliminary report of the distribution of marine algae of the islands in the Northern Japan Sea.** (Japanese with English résumé). Takesi HIROHASI. (Bot. Mag. Tôkyô **51**, 1937, 559-573).

The author has studied the flora of marine algae in three islands, Sado, Awaisima and Tobisima scattered in the northern part of Japan Sea. The names of all algae collected by him and others with their respective distribution in other regions are shown in an extensive table. Basing on the results of his studies he has attained to a certain conclusion concerning the distribution of marine algae which is contained in this paper.

**161. A new linden from Japan Proper.** (Japanese and Latin). Kiyotaka HISAUTI. (Jour. Japan. Bot. **13**, 1937, 210-213, 3 text-figs.).

*Tilia noziricola* is a new hybrid *T. Miyabei* JACK  $\times$  *T. japonica* SIMONK.



**162. Erysiphaceae in Japan.** Yasu HOMMA. (Jour. Fac. Agric., Hokkaido Imp. University **38**, 1937, 186-461, 11 pls.).

This monographic work contains besides a short introduction two parts, general and systematic. The general part is divided into three chapters, viz. morphology and physiology, host and parasitism, specialization and resistance. Concerning this part we will make a little remark. In respect to *Sphaerotheca fuliginosa* on *Taraxacum ceratophorum* the writer has described with illustrations the conjugation of the male and female nuclei in the ascogonium, forming a more or less large nucleus; in a later stage the writer has seen a young ascus with one large nucleus, and it seems that no normal fusion of the two nuclei in the incipient ascus was observed. Whether firstly the fusion of the male and female nuclei in the ascogonium really takes place and whether secondly, the fusion of the two nuclei in the incipient ascus is really lacking, ought perhaps to be reexamined.

In the systematic part the following genera are treated of (the figures within the brackets denote the number of species of each genus): *Cystotheca* (2), *Sphaerotheca* (6), *Podosphaera* (4), *Erysiphe* (7), *Uncinula* (23), *Typhlochaeta* (1), *Sawadaea* (3), *Microsphaera* (17), *Phyllactinia* (9), *Uncinulopsis* (1), *Leveillula* (1). Each species is described with figures, and for each the literature is given. The following are new: *Microsphaera ligustri*, *M. coryli*, *M. abeliae*, *M. viciae-unijugae*, *Sawadaea negundinis*, *Uncinula bifurcata*, *U. picrasmae*, *U. betulae* and *U. Nishidae*.

At the end of the paper a host index (pp. 429-442) and the list of cited literature (pp. 443-450), etc. are given.

**163. Nuntia ad floram japoniae XXXI-XXXII.** (With Japan. résumé). Masazi HONDA. (Bot. Mag. Tôkyô **51**, 1937, 56-59, 73-74, 94-96, 116-117).

The following new species with their respective diagnoses are contained in this paper: *Calamagrostis Hyamana* and *Miscanthus ryukyensis*.

**164. Two new species of thalloid Hepaticae from Japan.** (With Japan. résumé). Yoshio HORIKAWA. (Bot. Mag. Tôkyô **51**, 1937, 427-429, 3 text-figs., 615).

*Plagiochasma nipponica* and *Riccardia pelioides* are described with illustrations.

**165. Materials of the botanical research towards the flora of Micronesia (XIV)-(XV).** (Japanese with Latin diagnoses). Takahide HOSOKAWA. (Jour. Japan. Bot. **13**-1937, 191-203, 10 text-figs.; 274-284, 5 text-figs.).

Several plants from each of the following families, viz. Pandanaceae, Hydrocharitaceae, Palmae, Araceae, Liliaceae, Musaceae, Zingiberaceae, Orchidaceae, Piperaceae, Ulmaceae, Moraceae, Urticaceae, Balanophoraceae, Polygonaceae, Nyctaginaceae, Portulacaceae, Droseraceae, Connaraceae, Leguminosae, Meliaceae, Malpighiaceae, Euphorbiaceae, Sapindaceae, Rhamnaceae, Myrtaceae, Myrsinaceae, Sapotaceae, Asclepiadaceae and Rubiaceae are enumerated. Among them the following are new and described: *Freycinetia mariannensis*, MERR. var. *microsyncarpa* var. nov., *Scindapsus carolinensis* sp. nov., *Raphidophora trukensis* sp. nov., *Piper trukense* sp. nov., *Hyserpa* (?) *trukensis* sp. nov., *Hoya trukensis* sp. nov., *Dysoxylum abo* sp. nov., *Eugenia trukensis* sp. nov.

**166. Contribution to the knowledge of systematics of Morus in Japan IV. Morus in cultivation (II).** Teikichi HOTTA. (Acta Phytotax. et Geobot. **6**, 1937, 108-114).

First of all, a key for the determination of species, varieties and forms of *Morus* in culture is given. Almost all contained in this key are the forms newly named by



the author. They are: *M. bombycis*, its 4 varieties, and 1 forma; *M. alba*, its one variety and 3 forma; *M. latifolia* and 3 forma.

**167. Studies in the stripe disease of wheat.** (Japanese). Suehiko IKATA and Itirô KAWAI. (Bull. Agric. Exp. Sta. Okayamaken, Extra-No., 1937, 111 pp., 12 pls.).

The stripe disease of wheat is characterized by the formation on host leaves of yellow stripes with brown lines in their middle part which are continued up till the sheath and culm. This disease is due to *Cephalosporium gramineum* NISIKADO et IKATA. The infection takes place under soil through the root of host seedlings, whose vessels are finally filled up with mycelia and conidia. The liquid filtered out from the nutrient solution of this fungus contains a certain poison which prevents the growth of wheat seedlings. Since the conidia of this fungus die away by the action of water 29–39.5° within 20–40 days, they are not able to pass the summer in marshy field, but they may live quite healthily in dry fields during the summer.

Optimum temperature for their growth 20°C, maximum and minimum 30° and 5° respectively. Optimum temperature for conidia germination nearly the same as above.

Under humid condition the fungus dies within 96 hours at 40°C, within 12 hours at 45°, within 2 hours at 50°, within 1 hour at 55°, within 5 minutes at 60°. Under dry condition it may survive ½ hour at 80°. In respect to low temperature it was observed that the fungus has survived even 6 hours at –20°. In treating with corrosive sublimate which is most effective for killing the fungus its death takes place after 40, 35, 20, 15, 10, and 5 minutes by its solution which is 1/3000, 1/2500, 1/2000, 1/1500, 1/1000 and 1/500 respectively.

**168. Bud-variation in a flaked strain of *Rhododendron obtusum*.** Yoshitaka IMAI. (Jour. Coll. Agric., Tokyo Imp. Univ., 14, 1937, 93–98, 1 pl. and 1 text-fig.-group).

Concerning a garden variety of *Rhododendron obtusum* known by the name Tokonatu the author made a series of observations on its numerous clones. This variety is characterized by its corolla with red flakings on the white background. Through the somatic mutations as well as the somatic rearrangement of tissues various bud-variations are induced, and the mutations of flaked characters to self-red or to white are seen. Through the combination of the original and mutated histogens a great variety of sports take their origin.

**169. The duplication of petals in *Prunus serrulata*.** Yoshitaka IMAI and Kiyoo TABUCHI. (Jour. Coll. Agric., Tokyo Imp. Univ. 14, 1937, 99–152, 3 pls., 7 text-figs. and 77 tables).

The results of counting on 82 garden varieties of *Prunus serrulata* in respect to the duplication of petals are noticed in this paper.

The number of sepals ranges from 3 to 8, the mode being at 5. The under-numbered sepals seem to be of teratological, while the supernumerary ones are of hereditary nature. The number of petals in double flowers ranges in some cases from 35 to 61, the variation from the single to the double being continuous, although in some other cases a discontinuity between the single and the double is observed. The number of stamens varies between 10 and 122.

The total duplication is due either to petalomania or petaloidy. The primary duplication of petals takes place just in the same way as in *Prunus Mume* (cf. this Jour. 8, (7), No. 24). The secondary duplication occurs inside the intra-petals of the primary origin. Successive duplication takes place in the same way as the secondary.

**170. Über die aitiogene Dorsiventralität der Assimilationsorgane bei höheren Pflanzen.** (Mit japan. Zfg.). Shun-ichiro IMAMURA. (Bot. Mag. Tôkyô 51, 1937, 490-498, 620-621).

Betreffs den Assimilationsorganen der höheren Pflanzen ist es wohl bekannt, dass nicht selten ihre Dorsiventralität durch die äussere Einflüsse, wie Licht, Schwerkraft usw. bestimmt wird (aitiogene Induktion) und dass diese Dorsiventralität entweder stabil oder labil sein kann. Der Verf. hebt davon einige Beispiele aus der einschlägigen Literatur hervor. Sogar in ein und derselben Pflanze kann die Empfindlichkeit oder die Reaktionsfähigkeit gegenüber den äusseren Einflüssen verschieden sein in ihren einzelnen Gliedern, so um ein Beispiel hervorzuheben, steigert sich sie bei den Cupressinaceen und *Phyllocactus grandis* mit zunehmender Ordnung der Sprosse.

**171. Studies on the nodule bacteria VIII. Influence of ash content of the nodules on the growth of nodule bacteria, with a special reference to the titanium salts.** ARAO ITANO and AKIRA MATSUURA. (Ber. Ôhara Inst. landw. Forsch. 7, 1937, 501-515).

The ash content in the root-nodules of leguminous plants (*Astragalus sinensis*, bean, clover) is much smaller than that in their stems and leaves, thus for instance, 3.013% in the former against 8.016% in the latter. Of these ash contents the influence of titanic substances, such as titanic acid, titanium sulphate, potassium titanate, was studied, and it was proven that they may perform a slight stimulating action, but when their concentration exceeds a certain limit which is not very high their injurious effect comes about. Among the ash constituents contained in the nodules  $\text{Na}_2\text{O}$ ,  $\text{MgO}$  and  $\text{TiO}_2$  are found in somewhat large quantity in the nodules. Experiments were performed by adding the ash corresponding to 1 % of the original nodule to the nutrient agar medium instead of yeast extract formerly used. No effect of growth stimulation was observed. Formerly the authors could observe that the nodules of leguminous plants stimulate the growth of nodule bacteria. The negative result in the present experiment of ash addition indicates that the stimulating action of the nodules formerly observed is not due to the ash constituents, but to the organic substances contained in the nodules.

**172. Studies on the nodule-bacteria IX. On the electrical properties of the accessory substance.** ARAO ITANO and AKIRA MATSUURA. (Ber. Ôhara Inst. landw. Forsch. 7, 1937, 517-527, 1 graph).

The summary of the present investigation is as follows according to the authors' own words:

By electro-dialysis the accessory substance in the bean nodules was removed partly, but not completely. In all the extracts the accessory substance was chiefly found in the cathodic chamber, and some in the middle, while practically none in the anodic. Morphologically a majority of cells were short rod and rod, and the bacteria were comparatively few which were found in the anodic chamber. Electrically the accessory components in the nodules and yeasts seem to be different. The yeast extract was very inactive. No relation between the accessory substance and the nitrogen content was found, although the hydrogen ion concentration of the original solution seemed to have some influence.

**173. Studies on fresh water diatoms in Western Japan II-III.** (With Japan. résumé). YASUMI IWAHASHI. (Jour. Japan. Bot. 13, 1937, 252-261, 360-369, 8 text-figs. in all).

Some species of the genera *Meridion*, *Diatoma* (2), *Tabellaria* (2), *Actinella*, *Peronia*, *Neridium* (5), *Fragillaria* (7), *Rhoicosphaenia* are enumerated.

**174. Observations on the purple and green bacteria in a sulphur spring at Yumoto, Nikko.** (Japanese with English résumé). Tadao JIMBO. (Bot. Mag. Tôkyô **51**, 1937, 872-874).

The author has visited several times the famous sulphur spring at Yumoto, Nikko. Besides *Chromatium Weissei* which has long ago been announced by MIYOSHI and which lives in ditches, swamps and a lake of the thermal region the author has found *Chromatium vinosum* forming whitish purple colonies on decaying leaves in the swamp. Such different habitats of the two kinds of bacteria just cited seem to be related to the fact that while the former cannot live in the nutrient medium containing organic substances, the latter can live very well in such. Red bacteria, such as *Rhodospirillum longum*, *Chlorobium limicola* are found generally to accompany the colony of *Chromatium Weissei*, rarely a kind of *Chlorochromatium* also. *Chlorobium limicola* often forms yellowish green colonies and takes often the form of sulphur-turf (Schwefel-rasen).

**175. Studies on the physiology of earing in wheat.** (Japanese with English summary). Yôiti KAKIZAKI and Sinzaburô SUZUKI. (Jour. Imper. Agric. Exper. Sta. **3**, 1937, 41-92, 2 pls. and 2 text-figs.).

Experiments were carried out with wheat, *Triticum vulgare*, including 97 agromonomical varieties, on the earliness of earing as influenced (1) by different sowing dates from winter to summer, (2) by chilling the seedling at different growth stages and for different durations, (3) by chilling the seedlings sown at different dates, (4) by chilling the sprouted seeds for different durations, (5) by different temperatures under which plants grow, (6) by different daily photoperiods in the autumn and spring sowings, (7) by different daily photoperiods in the sowings at different dates, (8) by the short-day treatment for different periods, and (9) by different daily photoperiods after chilling. From the results of these experiments the following principle has been propounded in regard to the physiology of spring versus winter growing habits and earliness in this plant:

The so-called winter varieties have the nature to proceed towards immoderate vegetative growth. The intensity of this nature varies with varieties and it means exactly the intensity of winter nature, a variety without this nature being an absolute spring variety. The winter nature is cancelled completely or partially either by a low temperature during germination and early growth or by a short-day condition under which young plants grow. In other words, either a low-temperature or short-day condition at early stages of growth gives an effect to build up spring nature and transforms winter nature into spring nature. For the same reason, either a high temperature or long-day condition prevents the cancellation of winter nature. For the appropriate earing and fruitage in the winter variety, it is necessary that its winter nature is transformed into spring nature. In a case where the cancellation of winter nature is insufficient, the excessive vegetative growth takes place in response to the residual winter nature. Also, the excessive vegetative growth brings about a decrease of the activity for generative growth as a necessary consequence, and, in proportion of the intensity of the residual winter nature, earing is retarded and becomes late or ceased as well as fruits become poor even if eared. On the other hand, when the earliness on account of the rapidity of growth apart from the effect of winter nature is called "absolute earliness", earing in the absolute earliness is hastened either by a high temperature or by long days under which condition plants grow, and vice versa.

In some of the experiments, certain other characteristics were also observed. In the sowings at different dates from winter or early spring to summer, absolute spring varieties were apt to decrease gradually, with lateness of sowing the number of leaves on the main stem and also the weight per 1,000 grains. The decrease of the former is a simple phenomenon attendant on the hastening of earing by the rise of temperature and day-length, and that of the latter is attributed chiefly to the decreased ground growth. Varieties having winter nature, however, increased the number of leaves on the main stem and decreased markedly the seed weight with lateness of sowing. This is due to the increased residual winter nature caused by decreasing the cancellation of winter nature by the rise of temperature and day-length.

The varieties subjected have been classified into I-VII according to the intensity of winter nature.

KAKIZAKI.

**176. Botanische Untersuchungen über japanische Fadenpilze, die auf der Menschenhaut parasitieren.** (Mit japan. Zfg.). Toyoaki KAMBAYASHI. (Bot. Mag. Tôkyô **51**, 1937, 436-444, 2 Textabb., 616-617).

Aus einem Fall von trichophyticähnlichem Hautleiden, welches ein japanischer Diplomat während seines Aufenthaltes in Äthiopien bekam, hat der Verf. eine neue Art von *Cephalosporium* als Erreger des Leidens rein kultivieren können, und zwar als eine schwarze Kolonie auf SABOURAUDS Glykoseagar. Dieser Pilz ist als eine neue Art *C. nigrum* aufgefasst und seine morphologische Merkmale sind ausführlich beschrieben. Seine systematische Stellung wird auch diskutiert.

**177. Icones pandanarum micronesicorum (II).** (Japanese and English). Ryôzô KANEHIRA. (Jour. Japan. Bot. **13**, 1937, 322-331, 7 text-figs.).

The following species of *Pandanus* from Micronesia are described with illustrations of syncarps and habits: *Pandanus guamensis*, *P. Eyesyes*, *P. duriocarpus*, *P. erythrophloeus*, *P. divergens*, *P. insularis*.

**178. Karyological studies in *Crocus* I.** K. KARASAWA. (Japan. Jour. Bot. **9**, 1937, 1-15, 96 text-figs.).

**179. Life-history of *Schizomeris Leibleinii* KÜTZ.** (Japanese with English résumé). Yoshio KAWASAKI. (Bot. Mag. Tôkyô **51**, 1937, 25-30, 1 pl. and 4 text-figs.).

The life-history of *Schizomeris Leibleinii* was studied by the author on an artificial culture in a certain nutrient solution. The filament of this species produces the macro- as well as the microspores. Each of the former which is provided with 4 cilia and one eye-spot, after having escaped from the mother filament, soon germinates and forms a 111-300  $\mu$  long microscopical individual. From the latter the biciliate gametes issue out, which soon conjugate and form a zygote. The resting period of the latter is short, for it can germinate within one month, and gives rise to a filament. The life-history of this alga, so far as may be inferred from the author's observation just indicated, may be stated as follows:

mother-filament (2x)  $\rightarrow$  macrozoospore (x)  $\rightarrow$  microscopical individual (x)  $\rightarrow$   
 $\left\{ \begin{array}{l} \sigma \text{ gamete (x)} \\ \text{ } \end{array} \right. \searrow \text{zygote (2x)} \rightarrow .$   
 $\left\{ \begin{array}{l} \text{ } \\ \text{ } \end{array} \right. \nearrow \text{zygote (2x)} \rightarrow .$   
 $\left\{ \begin{array}{l} \text{ } \\ \text{ } \end{array} \right. \nearrow \text{zygote (2x)} \rightarrow .$

**180. Genetic studies on the chlorophyll defective segregates arising from interspecific hybrids. I. *Triticum persicum*  $\times$  *T. Timopheevi*.** (Japanese with English résumé). Hitoshi KIHARA. (Bot. Mag. Tôkyô **51**, 1937, 585-589, 1 text-fig.).



The hybrid *Triticum persicum* var. *stramineum*  $\times$  *T. Timopheevi* is highly sterile (4.8 % fertile). Four  $F_2$  offspring derived from it by the open pollination were also perfectly sterile except a single one. In  $F_3$  generation the latter has produced besides normal green yellow and albino offspring which have died away soon after their birth.

The author has proven through the genic analysis extending till the  $F_5$  generation the existence of one gene *y* for yellow and two duplicate genes  $a_1$  and  $a_2$  for albino, which are independently inherited. The genic formula for the chlorophyll character is as follows:

$A_1A_2Y$ ,  $A_1a_2Y$ ,  $a_1A_2Y$  for green  
 $A_1A_2y$ ,  $A_1a_2y$ ,  $a_1A_2y$  for yellow  
 $a_1a_2Y$ ,  $a_1a_2y$  for albino.

**181. Genomanalyse bei *Triticum* und *Aegilops*. VII. Kurze Uebersicht über die Ergebnisse der Jahre 1934-1936.** Hitoshi KIHARA. (Mem. Coll. Agric., Kyoto Imp. Univ. No. 41, 1-61).

Der Verfasser hat 61 Art- und Gattungsbastarde im Weizenverwandtschaftskreise genomanalytisch untersucht. Die Ergebnisse der karyologischen Beobachtungen und die Fruchtbarkeit der Bastarde sind in der folgenden Tabelle zusammengefasst.

Zusammenstellung der cytogenetischen Befunde bei den  $F_1$ -Bastarden, 1934-36

Bastarde	Anzahl d. Bind. (Mode)	Anzahl d. fest Bind.	Zahl d. Kompl.	Unreduz. Gameten	Anzahl d. homolog. Genome	Fruchtbarkeit
1934 ♀ <i>T. vulg</i> $\times$ <i>T. sphaero.</i> ♂	21	normal	sporad. kompl.	0	3	91.51
Rez.	"	"	"	"	"	94.84
<i>T. aeg.</i> $\times$ <i>H. villosa</i>	0-4	—	(0-1)III	0	0	0.00
<i>Ae. cyl.</i> $\times$ <i>Ae. spelt.</i>	0-6	0	0	R	0	0.07
<i>Ae. crassa</i> $\times$ <i>T. spelta</i>	$\pm 7$	1-3	(0-1)III (0-1)IV	0	0	0.00
<i>Ae. triarist.</i> 1 (6x) $\times$ <i>Ae. ventr.</i>	10-11	3	—	—	0 (1?)	—
" $\times$ <i>cyl.</i>	$\pm 12$	0-3	(0-3)III	0	0 (1?)	—
" $\times$ <i>triunc.</i>	bis $\pm 7$ (-9)	bis 4	(0-1)III	0 (K.E.)	0 (1?)	0.00
" $\times$ <i>triarist.</i> 2	21II	(nicht näher untersucht).		0	3	hoch fertil
" $\times$ <i>crassa</i>	5-12	$\pm 2$	(0-1)III	0	0 (1?)	0.19
<i>Ae. triunc.</i> $\times$ <i>S. cereale</i>	3-7 (m. 6)	0	0-3)III (0-1)IV	0	0	—
<i>Ae. ovata</i> $\times$ <i>S. cereale</i>	bis 4	0	(0-1)III (0-1)IV	0	0	—
<i>Ae. cyl.</i> $\times$ "	3-5	—	(0-1)III	0 (K.E.)	0	—
1935						
<i>Ae. triarist.</i> 5 (4x) $\times$ <i>T. durum</i>	0-6	bis 1	0-1	0	0	0.00
<i>Ae. caud.</i> $\times$ <i>spelt.</i>	1-5	0	0	0	R	vor d. Reife gestorben
<i>Ae. squar.</i> $\times$ <i>H. villosa</i>	0-5 (0)	0	0-1	0	0	0.00
<i>Ae. comosa</i> $\times$ <i>caud.</i>	4-5 (5)	2-3	bis 2	0	0	0.00



## (Fortsetzung)

Bastarde	Anzahl d. Bind. (Mode)	Anzahl d. fest Bind.	Zahl d. Kompl.	Unreduz Gameten	Anzahl d. homolog. Genome	Frucht- barkeit
<i>Ae. caud.</i> × <i>cyl.</i>	7	bis 7	0-2 (1)	0	1	0.07
			<i>F</i> <sub>1</sub> × <i>cyl.</i>			0.43
			<i>F</i> <sub>1</sub> × <i>caud.</i>			0.91
<i>Ae. ventr.</i> 1 × <i>ventr.</i> 2	14	12	fast im- mer <i>liv</i>	0	2*	89.83 (76.72)
„ 2 × „ 1	14	11	fast im- mer <i>liv</i>	0	2*	65.73 (65.98)
<i>Ae. triarist.</i> 5 (4x) × 1 (6x)	14	14 <sub>II</sub>	Komplexe (IV)	0	2	43.13 (20.45)
Rez.	14	„	„	0	2	48.56 (29.09)
<i>Ae. triarist.</i> 5 (4x) × <i>ovata</i>	6-12	1-5	(0-1) <sub>III</sub> (0-1) <sub>IV</sub>	0	0 (1?)	0.00
Rez.	6-9	—	—	0	0 (1?)	—
<i>Ae. triarist.</i> 1 (6x) × <i>cyl.</i>	8-14	zieml. viel	(0-3) <sub>III</sub> , 1v	0	0 (1?)	0.00
1936						0.10
<i>caud.</i> × <i>uniarist.</i>	4-6(sm)	0-1	0-1 <sub>III</sub>	0	0	0.00
<i>caud.</i> × <i>bicorn.</i>	0-5 (2)	0-2	(0-2) <sub>III</sub>	0	0	0.00
<i>caud.</i> × <i>ovata</i>	6-7	0-2	(0-2) <sub>III</sub> 1 <sub>IV</sub>	0	0(1 <sup>a</sup> )	1 M.K.
<i>ovata</i> × <i>caud.</i>	5-7	0-1	(0-1) <sub>III</sub>	0	0(1 <sup>a</sup> )	0.00
<i>caud.</i> × <i>umbell.</i>	3-6(sm)	0-1	(0-1) <sub>III</sub>	0	0	0.00
<i>caud.</i> × <i>ventr.</i>	4-7(sm)	0-2	(0-2) <sub>III</sub>	0	0(1 <sup>a</sup> )	0.00
<i>comosa</i> × <i>caud.</i>	4-5(sm)	2-3	(0-2) <sub>III</sub>	0	0	0.00
<i>caud.</i> × <i>column.</i>	6-7	0-4	(0-3) <sub>III</sub>	0	0	0.00
<i>caud.</i> × <i>variab.</i>	3-8(5)	0-1	(0-3) <sub>III</sub> (0-1) <sub>IV</sub>	0	0	0.00
<i>caud.</i> × <i>Kotsch.</i>	3-7(6)	0-1	(0-3) <sub>III</sub>	0	0	0.00
<i>triarist.</i> 4(x) × <i>caud.</i>	5-7(sm)	0-2	(0-2) <sub>III</sub>	0	0	0.00
<i>ovata</i> × <i>umbell.</i>	7 (sm)	bis 7	1 <sub>III</sub>	0	1(?)	0.00
<i>cyl.</i> × <i>umbell.</i>	6-8	0-2	(0-3) <sub>III</sub>	0	0(1 <sup>a</sup> )	0.00
<i>ventr.</i> × <i>umbell.</i>	0-5(2)	0	(0-1) <sub>III</sub>	0	0	0.00
<i>umbell.</i> × <i>comosa</i>	2-5(sm)	0	(0-1) <sub>III</sub>	0	0	0.00
Rez.	0-6(sm)	0	(0-2) <sub>III</sub>	0	0	0.00
<i>uniarist.</i> × <i>umbell.</i>	3-5(sm)	0	(0-1) <sub>III</sub>	0	0	1.69
<i>spelt.</i> × <i>umbell.</i>	2-5	0	(0-1) <sub>III</sub>	R	0	(0.6)
<i>ovata</i> × <i>variab.</i>	6-8	1-4	(0-3) <sub>III</sub> (0-1) <sub>IV</sub>	0	1	0.31
<i>variab.</i> × <i>Kotsch.</i>	13-14	bis 12	(0-2) <sub>III</sub> (0-2) <sub>IV</sub>	0	2	69.26 (13.74)
Rez.	13-14	bis 12	(0-2) <sub>III</sub> -1 <sub>IV</sub>	0	2	75.49 (13.51)

## (Fortsetzung)

Bastarde	Anzahl d. Bind. M ode	Anzahl d. fest Bind.	Zahl d. Kopl.	Unreduz. Gameten	Anzahl d homolog. Genome	Frucht- barkeit
<i>triarist.</i> (4x) × <i>variab.</i>	5-9	3-5	(0-1)III	0	1	0.00
<i>triunc.</i> × <i>variab.</i>	7-9	bis 4	(0-3)III (0-1)IV	0	0 (1?)	1 M. K.
<i>biccrn.</i> × <i>T. aeg.</i>	2-6(sm)	0-1	III & IV	0	0	0.00
Rez.	1-6(4)	0-2	(0-1)III	0	0	0.00
<i>cyl.</i> × <i>bicorn.</i>	2-7(sm)	0-2	Kompl.	0	0	0.00
<i>squar.</i> × <i>bicorn.</i>	0-7	0-2	(0-1)III	0	0	0.00
<i>comosa</i> × <i>uniarist.</i>	2-6	0-1	(0-1)III	0	0	0.36
<i>uniarist.</i> × <i>squar.</i>	2-6(4)(sm)	0-1	0	0	0	0.00
<i>uniarist.</i> × <i>bicorn.</i>	0-6(3)	0-1	(0-1)III	0	0	0.00
<i>cyl.</i> × <i>uniarist.</i>	± 6(sm)	0-1	(?-4)III	0	0	0.00
<i>cyl.</i> × <i>longiss.</i>	4-6	1	bis 3III bis 1IV	R	0	0.00
<i>biunc.</i> × <i>longiss.</i>	0-3	0	0	R. u. L.	0	0.31
<i>triunc.</i> × <i>biunc.</i>	6-9	bis 4	bis 1III bis 1IV	0	0 (1 <sup>s</sup> )	0.00
<i>biunc.</i> × <i>triarist.</i>	5-10(8)	0-5	(0-2)III (0-1)III	0	0 (1?)	0.00
<i>biunc.</i> × <i>ovata</i>	10-13(12)	bis 10	(0-2)IV	0	0 (1?)	0.00
<i>biunc.</i> × <i>column.</i>	6-9(7)	bis 7	(0-1)III	0	1	0.00
Rez.	7-9(8)	bis 7	(0-2)III (0-1)IV	0	1	0.00
<i>biunc.</i> × <i>variab.</i>	bis 7(sm)	bis 5	(0-1)III	0	0 (1?)	0.00
<i>Kotsch.</i> × <i>biunc.</i>	6-9(7)	1-5 (3-5)	(0-1)III (0-1)IV	0	1	0.33
<i>Kotsch.</i> × <i>triunc.</i>	(kein gutes Stadium)					0.00
<i>Heldr.</i> × <i>comosa</i> ( <i>comosa</i> 3 × 1)	7	5	1IV	0	1	83.74 (8.33)
<i>Heldr.</i> × <i>Heldr.</i> ( <i>comosa</i> 2 × 3)	7	7	0	0	1	84.18
<i>Heldr.</i> × <i>Heldr.</i> ( <i>comosa</i> 3 × 2)	7	7	0	0	1	89.39
<i>T. dicocc.</i> × <i>T. dicoccoid.</i>	12-14	12	0	0	2	84.18
<i>T. spelta</i> × <i>T. Tim.</i>	7-14(12)	3-7	0-2	0	1	0.53

## Abkürzungen:

R. = Regression (Unreduzierte Gameten entstehen durch Regression). K. E. = Kern-einwanderung. *T. vulg.* = *Triticum vulgare*. *shpaero.* = *sphaerococcum*. *aeg.* = *aegilopoides*. *H. villosa* = *Haynaldia villosa*. *Ae. cyl.* = *Aegilops cylindrica*. *spelt.* = *speltoides*. *triarist.* = *triaristata*. *ventr.* = *ventricosa*. *caud.* = *caudata*. *S. cereale* = *Secale cereale*. Sm = Schmierpräparat.

\* zeigt, dass das betreffende Genom (bzw. Genome) fast gänzlich homolog ist.

Ein Bastard *Aegilops speltoides* × *umbellulata*, der besonders zahlreiche Riesenpollenkörner mit unreduzierter Chromosomenzahl zeigt, hat viele amphidiploide F<sub>2</sub>-Nachkommen hinterlassen.

Der Verlauf der Pollenkornentwicklung wurde sowohl an reinen *Triticum*-Arten als auch an Bastardpflanzen ausführlich beobachtet. Bei den letzteren wird oft die Entwicklung der Pollenkörner in verschiedenen Stadien arretiert. Degenerationserscheinungen sind in manchen Bastarden zu sehen. Der Prozentsatz der normalen Pollenkörner ist für viele Bastarde eine guter Indikator ihres Fruchtbarkeitsgrades.

**182. The spodogram of the leaves of borraginaceous plants.** (Japanese with English résumé). Kôiti KIMURA. (Bot. Mag. Tôkyô **51**, 1937, 546-548, 2 text-figs. groups).

By using a nickel apparatus devised by the author and one collaborator instead of WERNER's or OHARA-KONDO's aluminium one he has studied the spodograms of a large number of the Borraginaceae. It was found in this investigation that the leaves are more or less hairy and that the hairs are manifold in their external characters. The hairs and some epidermal cells near them are silicified. The spodograms are very characteristic in respect to such hairs as well as some inorganic cell-contents.

**183. Physiologische und biochemische Untersuchungen über *Aspergillus itaconicus*. II.** Kôno KINOSHITA. (Acta Phytochem. **9**, 1937, 159-187, 7 Textabb.).

Der Autor beschäftigt sich in dieser Mitteilung mit den Bedingungen des Wachstums und den osmotischen Eigenschaften der Myzelien von *Aspergillus itaconicus* KINOSHITA, der sich durch seine Fähigkeit zur Itakonsäurebildung auszeichnet. Dieser Schimmelpilz wächst üppig nur auf den Nährlösungen, die 20-30 %-igen Zucker oder 1-2 n Salze enthalten. Diese merkwürdige tono- oder osmophile Lebensweise dieses Pilzes steht mit der Tatsache in Einklang, dass seine Fundort der kochsalzreiche "Umesu"-Saft ist. Den osmotische Wert des Zellsaftes ermittelte der Autor durch die Bestimmung der Gefrierpunktserniedrigung des Presssaftes der Myzelien, die in hochkonzentrierten Medien gewachsen sind, und dementsprechend hoch gefunden, wenn auch hierbei der osmotische Koeffizient, d.h. die Verhältnisszahl: Osmotischer Druck des Presssaftes, osmotischer Druck des Aussenmediums, sich vielfach kleiner als 1 erwies. Der Autor erklärte dies dadurch, dass die in hochkonzentrierten Medien wachsenden Myzelien auffallende Formänderungen zeigen, die sich hauptsächlich darin äussert, dass die Hyphen mehrmals verdickt und inhaltreich erscheinen und quellungsfähige Substanzen enthalten. Die Myzelien, die in hochkonzentrierten kaliumchloridhaltigen Nährlösungen aufwachsen, werden niemals zur übermässigen Kaliumaufnahme veranlasst.

**184. On the species of *Clematis* sect. *Tubulosae*.** (With Japan. résumé). Masao KITAGAWA. (Jour. Japan Bot. **13**, 1937, 343-360, 3 text-figs.).

First of all the DECAISNE's diagnosis of the sectio *Tubulosae* is presented. Then come a key for the species determination as well as the critical notes on various species, viz. *Clematis speciosa* MAKINO, *C. urticifolia* NAKAI, *C. stans* SIEB. et ZUCC., *C. psilandra* KITAGAWA nom. nov., *C. heracleifolia* DC., *C. tubulosa* TURCZ., *C. tsugetorum* OHWI, *C. Takedana* MAKINO, and *C. Joviniana* SCHN.

**185. Some plants from Inner Mongolia collected by Mr. T. AKAGI in the year 1937.** (Japanese with Latin diagnoses). Masao KITAGAWA. (Jour. Japan. Bot. **13**, 1937, 425-434).

Plants collected very recently by Mr. T. AKAGI in "terra ordos" of Inner Mongolia are enumerated. In all the collection contains 100 species, of which the following are described as new: *Thalictrum squarrosus* var. *microphylla* var. nov. and *Geblera Akagii* sp. nov. Some few remain undetermined.

**186. Contributio ad cognitionem florum manshuricae X.** (With Japanese résumé). Masao KITAGAWA. (Bot. Mag. Tôkyô **51**, 1937, 150-157, 5 text-figs., 176-177).

The following are new species: *Diarrhena Yabeana*, *Glyceria effusa*, *Atriplex subcordata*, *Erysimum arvense*, *Gentiana Takedai*.

**187. Expositiones plantarum novarum orientali-asiaticum 2.** (With Japan. résumé). Siro KITAMURA. (Acta Phytotax. et Geobot. **6**, 1937, 18-23).

The following are new: *Patrinia formosana*, *Tubocapsicum obtusum*, *Cirsium Maruyamanum*, *Taraxacum Maruyamanum*.

**188. An enumeration of Compositae of Formosa.** Siro KITAMURA. (Acta Phytotax. et Geobot. **6**, 1937, 79-88).

Among a number of plants enumerated *Siegesbeckia formosana* is a new species.

**189. Contributio ad cognitionem generis Chrysanthemi sinæ.** (With Japan. résumé). Siro KITAMURA. (Jour. Japan. Bot. **13**, 1937, 162-171).

*Chrysanthemum Namikawanum* and *C. lushanense* are described as new species.

**190. On the genus Holtermannia of Tremellaceae.** Yosio KOBAYASI. (Sc. Rpts., Tokyo Bunrika Daigaku, Sec. B, No. **50**, 1937, 75-81, 1 pl. and 2 text-figs.).

The species belonging to the genus *Holtermannia* established in 1910 by SACCARDO and TRAVERSO were formerly included among the genus *Tremella* or *Clavaria*; and for them a special genus *Clavariopsis* was created by HOLTERMANN (1898). In classifying various species of this genus the author has established two new sections, *Holtermannella* and *Coralloides*. Under the former *H. corniformis* sp. nov. and 4 other species are included, while in the latter *H. coralloides* sp. nov. stands alone.

**191. On the specific connection of Cordyceps entomorrhiza and Tilachlidiopsis nigra.** (With Japan. résumé). Yosio KOBAYASI. (Bot. Mag. Tôkyô **51**, 1937, 97-102, 1 pl. and 3 text-figs.).

Among a number of specimens of *Tilachlidiopsis* which are parasitic on the insects belonging to the Carabidae, the author possesses only two with stromatiferous fruit-bodies, all other being the conidial forms. *Cordyceps entomorrhiza* was found in a certain limited part of Europe, many which are called by this name being really other species. *C. gracilis* is found sometimes in Japan. Two conidial forms of *Cordyceps entomorrhiza* were recently found by PETCH, viz. *Hirsutella Eleuthratorum* and *Stilbella setiformis*.

When one compares *Tilachlidiopsis* with stromatiferous fruit-bodies and *Cordyceps entomorrhiza* to each other, both of which are parasitic on the Carabidae, it will be seen that the vegetative bodies of both are in perfect accord. Their stroma resembles also perfectly to each other, only except the fact that in *T.* the perithecia are immature. The conidia of *C. entomorrhiza* and what are considered to be the conidia of *T.* also resemble very much to each other. On the basis of such facts the author thinks that the two species under consideration are the connected forms, the one of which should have been derived from the other in either of the two alternative directions.

**192. Development and structure of a new species of Octaviania (Hymenogasteraceae).** (With Japanese résumé). Yosio KOBAYASI. (Bot. Mag. Tôkyô **51**, 1937, 291-298, 1 pl. and 8 text-figs., 404).

The American botanist DODGE has transferred *Octaviania asterosperma* to *Aranceliella*, together with all members of the former genus, so that the genus *Octaviania*

seems to have disappeared. The author has followed up the development of a fungus of the genus which he thinks to belong to *Octaviania* and has found that it should be placed among the "koralloider" type (LOHWAG), though it shows a certain feature of the "mehrütiger" type, whereas the members of *Hydnangium* and *Arcangeliella* are regarded to belong to the "einhütiger" type. On the basis of such facts the author thinks that the genus *Octaviania* should be retained and distinguished from *Hydnangium* and *Arcangeliella*.

The fungus studied by the author is called *Octaviania columellifera* sp. nov. and described in full detail.

**193. On the classification of the Juglandaceae.** (Japanese and Latin). Gen'iti KOIDZUMI. (Acta Phytotax. et Geobot. **6**, 1937, 1-17).

The family Juglandaceae is divided into two new subfamilies, viz. Nuciferoideae and Drupoideae based principally on the nature of fruits. The further classification is as follows:

- Subfam. I. Nuciferoideae KOIDZ.
  - Tribus I. Petrophiloidieae KOIDZ.
    - Gen. 1. *Petrophiloidea* BOWERBANK.
  - Tribus II. Pterocaryeae KOIDZ.
    - Gen. 2. *Pterocarya* KUNTH.
    - Gen. 3. *Engelhardtia* LESCHEN.
- Subfam. II. Drupoideae KOIDZ.
  - Tribus III. Alfaroeae KOIDZ.
    - Gen. 4. *Alfaroa* STANDL.
  - Tribus IV. Caryeae KOIDZ.
    - Gen. 5. *Juglans* LINN.
    - Gen. 6. *Carya* NUTT.

**194. New plants from Ryukyu Islands.** (Japanese with Latin diagnoses). Gen'iti KOIDZUMI. (Acta Phytotax. et Geobot. **6**, 1937, 46-47).

*Sugerockia Kawanoi* KOIDZ. sp. nov. (= *Heloniopsis Kawanoi* KOIDZ.) and *S. leucantha* KOIDZ. sp. nov. (= *Heloniopsis leucantha* KOIDZ.).

**195. Bambusacea novae japonicae IV.** Gen'iti KOIDZUMI. (Acta Phytotax. et Geobot. **6**, 1937, 65-78).

The following new species are described: *Arundinaria arvensis*, *A. caudiceps*, *A. imadatensis*, *A. Muroiana*, *A. Nakashimana*, *A. shinonoana*, *Pleiolobus akasiensis*, *P. Nakashima*, *Sasa basibarbigera*, *S. basihirsuta*, *S. buddhistica*, *S. gigantissimum*, *S. hizenensis*, *S. iwamiana*, *S. kaiensis*, *S. koshiensis*, *S. kuzakaina*, *S. macrophylla*, *S. Maruyamana*, *S. myojinensis*, *S. minoensis*, *S. Muroiana*, *S. nandaiensis*, *S. Uchidana*, *S. yanaiensis*, *S. suprapilosa*, *S. tonamimontanus*, *S. Umuizoa*.

**196. On the influence of oxygen supply upon the division and elongation of cells in the root.** Hitoshi KOJIMA. (Cytologia, Fujii Jub. Vol., 1937, 569-575).

Seedlings of *Vicia Faba* were used as the materials of experiments. Their roots were placed partially in the KNOP's solution. The latter was either bubbled, 1. with oxygen-less air, 2. with normal air, and 3. with pure oxygen, or not at all aerated. The duration of each experiment was 24 hours. The general conclusions drawn from the above experiments were as follows. The elongation of the root is considerably influenced by the oxygen supply, and its degree as well as the frequency of cell-divisions



increased or decreased according as the oxygen supply was great or small. So also it was with the elongation of individual cells; it was ascertained that the frequency of cell-divisions has far greater influence than the latter for the elongation of the root.

**197. Die Bestimmung des spezifischen Pulvergewichtes an den verschiedenen Partien des Pflanzenkörpers und ihre physiologische Bedeutung.** (Japanisch mit deutsch. Zfg.). Riichiro KÔKETSU und Yoshizo IMAMURA. (Bot. Mag. Tôkyô, **51**, 1937, 317-324).

Das sog. spezifische Pulvergewicht wurde an verschiedenen Körperpartien von *Helianthus annuus* und einigen anderen Arten bestimmt. Der gefundene Wert war im grossen und ganzen an den höheren Partien des Pflanzenkörpers grösser als an den niederen, und zwar sowohl bei normalen als auch bei verwelkten Pflanzen. Vorausgesetzt, dass eine Gewebepartie mit höherem spezifischen Pulvergewicht ein höheres Wasserfesthaltungs- oder Wassersaugungsvermögen besitzt, weil es nach dem Ergebnis einer KÔKETSU'schen vorherigen Arbeit sehr wahrscheinlich sein muss, mag das erwähnte Resultat dieser Arbeit eine physiologische Bedeutung haben, indem es die Richtung der Wasserwanderung im Pflanzenkörper begründet. Die Bestimmung des genannten Wertes kann daher vielleicht als ein erfolgreiches Hilfsmittel bei der Forschung der Wasserphysiologie fungieren.

KÔKETSU.

**198. Über die Konvektion und Verdunstung als physikalische Komponente der Transpiration. (Vorläuf. Mitteil.)** (Mit japan. Zfg.) Kwan KORIBA. (Bot. Mag. Tôkyô **51**, 1937, 461-472, 1 pl.)

Der Verfasser hat zuerst durch eine neue Methode der Rauchprobe für schwache Strömung die autogene Konvektion untersucht. Es wurde mit  $10^3$  cm Küvette aus Kupfer die Strömungslinien der Autokonvektion anschaulich gemacht, und die Strömungszeit und -Geschwindigkeit in Bezug auf die Temperaturdifferenz und die Strömungszeit und -Geschwindigkeit in Bezug auf die Temperaturdifferenz und die Strömungsweite mit Formeln ausgedrückt. Dann wurden einige andere Fälle von Autokonvektionen, nämlich die längs den geneigten oder vertikalen, nassen Kartonplatten vorbeiziehenden, die um eine quergestellte Zylinderoberfläche herumlaufenden, und die über die Wasseroberfläche entstehenden Konvektionen bildlich dargestellt. Ausserdem wurden die zusammengesetzten Konvektionen und die Reibungsschicht über der Metallnetzfläche durch die Rauchmethode ausprobiert. Weiter wurde die ungleiche Verteilung der Verdunstung im autokonvektiven Stromfeld durch eine abgeteilte Verdunstung der vertikalen Kartonplatten klargestellt, und die Verdunstungsbeschleunigung durch Freiraumdifusion durch einige Beispiele erläutert. Zuletzt wurde die Wirkung der Lufttemperatur auf die Verdunstung vorläufig mitgeteilt: "Die Autokonvektion wirkt auf die Verdunstung der in Verdunstungskälte befindlichen Körper mit der Lufttemperaturerniedering beschleunigend ein, wie man aus dem Verdunstungskoeffizienten ermassen darf und zwar desto mehr, je grösser das Sättigungsfizit ist."

Autoreferat.

**199. Studien über die Atmung von *Azotobacter chroococcum* mit besonderer Berücksichtigung der  $N_2$ -Assimilation und CO-Hemmung. Zur Physiologie von *Azotobacter*. I.** Hideo KUBO. (Acta Phytochim., **10**, 1937, 219-238).

Essigsäure, Buttersäure, Capronsäure, Brenztraubensäure, Äthylalkohol und *n*-Butylalkohol dienen *Azotobacter chroococcum* als gutes Atmunssubstrat. Die Versuche über die KCN-Hemmung zeigen deutlich, dass die Veratmung dieser Substrate durch *Azotobacter* durch KCN zwar sehr stark, aber nicht vollständig unter-

drückt wird, oder in anderen Worten, dass dabei die Mitwirkung sowohl des durch M/500–M/1000 KCN schon gänzlich hemmbaren Indophenolase-Cytochromsystems als auch des anderen KCN-beständigen Atmungssystems zu bemerken ist. Nach einer unter Abzug der Nichtcytochrom-Atmung ausgeführten Umrechnung von MEYERHOFschen Angaben wurde die Gültigkeit der Verteilungsformel O. WARBURGS auch für die CO-Hemmung der *Azotobacter*-Atmung wahrscheinlich gemacht.

Der Energieaufwand bei der  $N_2$ -Assimilation sowie beim Wachstum bedingt freilich bei *Azotobacter* eine gesteigerte Sauerstoffatmung. Hydroxylamin und Ammoniumsalze hemmen bekanntlich die  $N_2$ -Assimilation von *Azotobacter*, aber die letzteren Salze lassen dabei noch das Wachstum der Bakterien zu. Bei Veratmung des Äthylalkohols und einiger anderen Substrate durch *Azotobacter* wurden die Respirationsquotienten in An- oder Abwesenheit des Hydroxylamins sowie des Ammoniumsalzes manometrisch bestimmt. Die erhaltenen Ergebnisse lassen sich gut aus dem angenommenen Zusammenhang der Atmung mit  $N_2$ -Assimilation und Wachstum erklären. Verfasser.

**200. *Ranzania japonica* (Berberidac.). Its morphology, biology and systematic affinities.** Masao KUMAZAWA. (Japan. Jour. Bot. **9**, 1937, 55–70, 6 text-figs.).

**201. On the structure of the cell nucleus.** (In Japanese). Yoshinari KUWADA. (Nippon Biseibutugaku Byôrigaku Zassi (Japanese Journ. Microb. and Pathol.) **30**, 1936, 1689–1691).

In this paper the structure of the nucleus is discussed on the basis of the spiral structure of the chromosomes as well as the results of the hydration-dehydration experiments on nuclei by STROHMEYER and by SHINKE, and it is concluded that the nucleus is of the chromonema structure like the chromosomes, with an essential difference from the latter that the chromonemata are very loosely and irregularly coiled while in the chromosomes they are coiled into more or less regular spirals, and that the divergency in visibility of the nuclear structure is due, in harmony with the view of the authors named above, to a mere change in the refractivity of the nuclear components which depends on their hydration or dehydration grades. The problem of heteropycnosis is also discussed briefly, and it is suggested that the heteropycnosis is a phenomenon which may be interpreted in connection with the fact of the artificial uncoiling of the chromonema spirals of those chromosomes by OURA. Author.

**202. A morphological view of meiosis.** (In Japanese). Yoshinari KUWADA. (Kyôdai Dôsyokubutugaku Kyôshû Dôshûkai Kaihō (Rep. Zool. Bot. Almuni Assoc., Kyoto Imp. Univ. No. **2**, 1937, 1–9).

FARMER's view of meiosis being re-examined in the light of the recent investigations into the behaviour of chromonemata in mitosis and meiosis, the conclusion is reached that the view of FARMER that "the essential peculiarities of the meiotic phase" can be explained as due to "the coherence in pairs of premeiotic chromosomes" or syndesis and to the intercalation of "a special form of chromosome-distribution" or an extra division during the course of "what would not differ materially from an ordinary premeiotic mitosis" is correct. There is no reason to suppose that the reductional division is a division transformed from the normal mitosis. The behaviour in the longitudinal splitting, and the divergency in the state of coiling during the interkinesis, of the chromonemata points, on the other hand, to the conclusion that the two divisions in meiosis must represent one cycle of the normal mitosis. A further examination of the problem from the view point of the abnormal meiotic divisions in hybrids and those experimentally induced leads one to the conclusion that the syndesis and the extra division which latter functions as reductional division only in its taking place

of the former are a pair of inseparable phenomena for the normal performance of the life cycle of the bi-sexual organisms, neither one of them alone being able to realize the chromosome reduction. If, therefore, it is assumable that the syndesis occurred in the evolutionary history of these organisms to take place during the course of a normal mitosis under a certain condition such as, for instance, that assumed by DARLINGTON in his precocious theory or that by SAX in his retardation theory, it must be admitted that the extra division was intercalated at the same time. This conclusion may explain the reason why in the meiosis two divisions take place successively.

Author.

**203. The hydration and dehydration phenomena in mitosis.** Yoshinari KUWADA. (Cytologia, FUJII Jubilee Volume, 1937, 389-402).

In this discussion the author takes up five topics, which are concerned more or less directly with the phenomena, hydration and dehydration. The headings given are:- 1. The restitution nucleus. 2. The heteropycnosis. 3. The structure of the resting nucleus. 4. The coiling mechanism of the chromonemata. 5. The chromomere. Under the fourth heading a new hypothesis is put forward. In the conclusion, it is emphasized that "in mitosis water relation is very important in order that the normal processes may take place", and it is pointed out that "there may be many problems both in mitosis and meiosis which are concerned with changes in water-relation", and that "investigations on this line of inquiry could clear up many morphological problems remaining hitherto obscure".

Author.

**204. Chiasma localisation.** (In Japanese). T. MAEDA. (Japan. Jour. Genet. **13**; 1937, 121-125).

In this paper a general review of the studies on chiasma localisation is attempted. The term 'chiasma localisation' is briefly explained, and the essential points in the results of observation by JANSSENS (1924) in *Stethophyma grossum*, by NEWTON and DARLINGTON (1930) in *Fritillaria meleagris*, and by LEVAN (1933) in *Allium fistulosum* are reviewed. The theory which interprets the origin of chiasma localisation by the assumption of genotypic control is also reviewed in connection with the results obtained by the author in the  $F_2$  and backcross hybrids from *Allium fistulosum*  $\times$  *Allium Cepa* (Japan. Journ. Genet. **13**, 146-159), results which are hardly in harmony with the theory.

Author.

**205. Le caractère et les affinités de la flore alpine de Taïwan (Formose).** (Avec un sommaire japonais). Genkei MASAMUNE. (Bot. Mag, Tôkyô **51**, 1937, 232-235, 397-398).

L'auteur donne au premier abord le nombre des genres et espèces des plantes de la flore alpine de Formose contenues dans chacune de 43 familles énumérées. Le nombre des genres énumérés dans cet article est 55 et celui des espèces est 343 (plantes vasculaires). Parmi 373 espèces citées ci-dessus 243 sont endémiques, ce qui correspond à 63 pour cent de la flore alpine entière (ce que l'auteur nomme le degré de spécialisation). Cet haut degré de spécialisation montre que la flore alpine de Formose doit avoir été isolée depuis assez longtemps.

La flore alpine de Formose se compose des éléments nipponais (ou japonais), sino-hymalais et malais. Il est à remarquer que le nombre du second élément l'emporte sur celui de chacun des deux autres. Cet avis de l'auteur se diffère de celui de HAYATA, selon lequel la flore des régions alpines de Formose a la plus grande affinité avec celle des îles principales du Japon.

**206. Zwei unerwartete 36-chromosomige Pflanzen in der Rückkreuzung *Triticum polonicum* × (*T. polonicum* × *T. spelta*).** Seiji MATSUMURA. (Cytologia, FUJII Jub. Bd. 1937, 293-298, 12 Textabb.).

Die Rückkreuzungen  $F_1 \times$  Dinkel sowie  $F_1 \times$  Emmer ergeben im allgemeinen 35- bis 42- bzw. 28-35-chromosomige Pflanzen. Im Jahre 1935 hat der Verf. unerwarteterweise eine 44-chromosomige Pflanze bei *T. spelta* ×  $F_1$  und zwei 36-chromosomige Pflanzen bei *T. polonicum* ×  $F_1$  bekommen. Die letzteren dürften daraus entstanden sein, dass 14-chromosomige Eizellen von *T. polonicum* durch 22-chromosomige Spermatkerne von  $F_1$  befruchtet worden ist. Nach den Beobachtungsergebnissen des Verf. über die Reifungsteilungen solcher 36-chromosomigen Pflanzen findet man häufig  $15_{II} + 6_I$ , doch selten  $1_{III} + 14_{II} + 5_I$  und  $14_{II} + 8_I$ . Die Trivalenten sind meistens V-förmig, selten Y-förmig oder sogar geradlinig. Oft beobachtet man ausser den gewöhnlichen Chromosomen 1 Chromosomfragment. Unter zwei von dem Verf. bekommenen 36-chromosomigen Pflanzen ist die eine minder fruchtbar als die andere, doch bei der ersteren sind nicht nur die Samenkörner viel keimungsfähiger als bei der letzteren, sondern auch ist die Lebensfähigkeit der Keimlingen viel grösser.

**207. On a triploid *Wistaria* and the problem of eutely.** (In Japanese with English résumé.) Hazime MATSUURA. (Bot. and Zool. 5, 1937, 15-24, 12 text-figs.)

Two individuals of *Wistaria floribunda* DC., one diploid ( $8_{II}$ ) and the other triploid ( $8_{III}$ ), were compared to each other in respect to several quantitative characters of the leaf. The results from a statistical study indicate that about the length of cells the ratio between the diploid and the triploid is approximately 47:53, while the number of cells per area gives the reverse relation, i.e., 53:47. The data were explained by assuming that in the present material both (1) the "Kernplasmarelation" and (2) the eutely or the cell-constancy of the organ are fairly maintained. It is to be expected from these two principles that the triploid shows in comparison with the diploid a gigantism of 53.37/46.63 in one dimension (60/40 in volume) for each organ.

Author.

**208. On the arrangement of the chromosomes in the mitotic figure of *Crepis capillaris* L. WALLR.** (With Japanese résumé.) Hazime MATSUURA. (Bot. Mag. Tôkyô, 51, 212-221, 1935).

It was concluded from (1) observations on the development of chromosome arrangement on the mitotic equator and from (2) a statistical study on the metaphase figures that in *Crepis capillaris* there is no evidence of somatic pairing.

The relation of somatic pairing to secondary pairing in meiosis is discussed in connection with the mitosis-meiosis relationship.

Author.

**209. Chromosome studies on *Trillium kamtschaticum* PALL. V. Abnormal meiotic divisions due to high temperature.** Hazime MATSUURA. (Cytologia, FUJII Jub. Vol., 1937, 20-34, 2 pls., 23 text-figs. and 2 diagrams).

Several abnormal chromosome types were produced by subjecting *Trillium* plants to high temperature (ca 16°C) prior to the meiotic divisions. Under natural conditions, the meiotic divisions of this plant usually take place in early spring under snow.

The abnormalities are due to the acceleration in the behavior of the kinetochore and of the rest of chromonemata. There are two types of acceleration: balanced (or concordant) and unbalanced (or discordant).

The balanced anomalies are quite normal in the mode of bivalent formation and the subsequent behavior of chromosomes, but abnormal in the dimensions of chromosomes and of entire mother-cells. In the extreme case, the cell is exceedingly small and the chromosomes are very short, nearly one-half of the normal ones.



The unbalanced anomalies consist of several types of the upsets in timing relationships between the kinetochore and the other part of the chromonemata. They are: complete failure of synapsis (asynapsis), premature separation of the associated kinetochores (desynapsis), both resulting in the formation of 10 univalents instead of 5 bivalents, and premature separation of chromatids (precocious). These are fully described and illustrated in the original paper. Author.

**210. Karyological polymorphism of *Phacellanthus tubiflorus* SIEB. et ZUCC. (A cytological study on *Phacellanthus tubiflorus* SIEB. et ZUCC. II).** (In Japanese with English résumé). Hazime MATSUURA and Tetu TOYOHUKU. (Japan. Jour. Gen. **13**, 1937, 21-30, 6 text-figs.).

In a previous paper, the senior author gave three different chromosome numbers,  $n = 21, 35$  and  $42$ , in different plant groups of this parasitic herb. In the present paper, several other chromosome numbers are described, such as  $19_{II}, 38_{II}, 19_{III}, 38_{II} + 1_I$  and  $39_{II}$ .

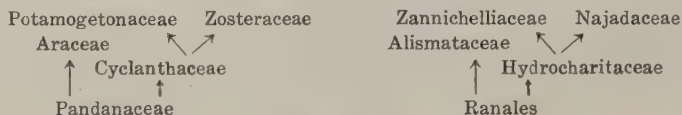
In meiosis of these types it was noticed that (1) no multivalents are formed, (2) the secondary association of bivalents occurs markedly and (3) non-disjunction and non-conjugation of certain bivalents are frequently met with. There is an evidence indicating the possibility of autosynapsis in the members of the haploid set. From these considerations, it was concluded that the basic number 7 which was inferred from the numerical relation of the 21-35-42 series is also applicable to the present 19-38 series. Authors.

**211. A new species of *Scutellaria* from China.** (With Japan. résumé). Hisao MIGO. (Bot. Mag. Tôkyô **51**, 1937, 230-232, 397).

*Scutellaria simplex* is a new species endemic in China. Its diagnosis is presented.

**212. The origin of *Najas* and *Potamogeton*.** (With Japan. résumé). Shigeru MIKI. (Bot. Mag. Tôkyô **51**, 1937, 472-480, 3 text-figs., 619).

*Najas* and *Potamogeton*, both of which are, as well known, aquatic plants with apetalous flowers, are often considered to be closely related to each other systematically. In this paper the author, on the basis of his consideration of the morphological characters of both genera, attains to the conclusion that they are not so closely related as generally supposed and that they may be even very distant phylogenetically. According to the present author the production of flowers and lateral shoots from the same axil, as seen in *Najas*, is common in Hydrocharitaceae and this fact will point out towards the close affinity existing between the two. Furthermore, Africa may be the original home of *Najas*, where many primitive species and allied genera exist. On the other hand, the flowers of *Potamogeton* is to be regarded as a reduced inflorescence, i.e. as a central fertile flower surrounded by 4 staminate flowers, as in the flower of Cyclanthaceae. The origin of this genus from Helobiae is improbable, and it might have been derived from Synanthae or Pandanales. The phylogeny of *Najas* and *Potamogeton* are expressed as follows by the author:





**213. The water phanerogams in Japan, with special reference to those in Province Yamasiro** (Japanese). Shigeru MIKI. (Rpt. from "Studies of Historical and Natural Monuments in Kyôtohu" **18**, 1937, 128 pp., 4 pls. and 66 text-fig. groups.)

After the general consideration of water-plants (preface, classification, habitats, adaptative capability against the surrounding influences) the author passes to the detailed description of marsh plants in Yamasiro Province with rich illustrations. Of 25 families, 46 genera, 119 species, 6 varieties and 10 hybrids of water plants which have been hitherto found in whole Japan 29 genera (=80% of the whole) and 57 species are seen in Yamasiro. The following are new species: *Utricularia multi-spinosa*, *Potamogeton monoginus*, *Nuphar ozeensis*, *N. subpumilum*. *N. japonica* DC. var. *stenophyllum* is a new variety; *Potamogeton Fauriei* and *P. malainoides* are new hybrids. *Ambulia stipitata* HAYATA, *Utricularia ochroleuca* HART. and *Callitriche autumnalis* are new to Japan.

**214. On sulphates of polysaccharide, as derived from the cell-wall contents of brown algae.** (Japanese with English résumé), Tomoo MIWA. (Bot. Mag. Tôkyô **51**, 1937, 549-553).

*Fucus evanescens*, *Eisenia bicyclis* and *Laminaria angustata* were studied concerning the mucilaginous substance forming the contents of the mucilage passages. First of all, it was established that the mucilage is of acid nature and that fucose and sulphate exist in almost equimolecular ratio, whence this substance is considered as a polymer of the acid fucose monosulphate. The mucilage of *Eisenia* yields by hydrolysis not only free sulphate and fucose but also a considerable amount of glucose. Since probably the molecular ratio of fucose to organic sulphate is almost 1:1 it is supposed that the sulphuric acid is bound to fucose as an acid monosulphate. The mucilage of *Laminaria*, contrary to that of *Eisenia* and *Fucus*, is very resistant against hydrolysis, and by this process gives rise to sulphate and sugar, and neither fucose nor glucose was yet detected. The results of the author's studies hitherto done show that the mucilage of various brown algae is not uniform in its nature.

**215. On the significance of the SCHMIDT'S line in the plant distribution in Saghalien.** Kingo MIYABE and Misao TATEWAKI. (Proc. Imp. Acad. **13**, 1937, 24-26, 1 text-fig.).

Friedrich SCHMIDT who has made an extensive botanical survey in south-western part of Saghalien has concluded that the floral character of this district is essentially that of the northern extension of the flora of Japan. On the basis of this survey SCHMIDT has divided Saghalien into two botanical districts by means of a line extending from the mouth of the River Poronai in Patience Bay to a point somewhere between Mgatsch and Tangi on the coast of Japan Sea. Yûshun KUDÔ who made an extensive botanical study in Northern Saghalien has found that the flora of this part is essentially that of subarctic region, thus confirming the view of SCHMIDT and called the line under discussion the SCHMIDT line. Through the more detailed investigation of the flora of Northern Saghalien of the junior author as well as some others who have found a large number of new plants, the view of SCHMIDT was further confirmed, and the significance of the SCHMIDT line was strengthened.

**216. Differentiation period of flower buds in tea plants.** (Japanese). Bungo MIYAZAWA. (Agric. & Hort. **12**, 1937, 1084-1092).

The following observations were done in Miyazaki City in Southern Kyûsyû.

The flowering period of the tea plant extends from the end of August till December, and flower buds begin to be differentiated already in the beginning of June. Erect branches which are actively growing attain the differentiation period of their flower buds later than others. Flower buds are generally produced, beginning with the third node of the shoot (counted from its base), but sometimes even at the first node. In the latter case the flower buds are very numerous and the flowering continues till December. Though the differentiation of flower buds begins to take place at the beginning of June, it proceeds very slowly till the middle of July, and then rapidly in August, so that in the middle of September lower buds are often discernible even to the naked eye.

**217. Über einige *Iris*-Arten als Indikatorpflanzen japanischer Moore.** Manabu MIYOSHI. (Proc. Imp. Acad. **13**, 1937, 86-87).

Dank seiner Beobachtung, besonders bei einer breiten Bergwiese Akanumagahara in Nikkô Nationalpark hat der Verf. die Tatsache festgestellt, dass unter drei im dortigen Moore bewohnenden *Iris*-Arten, nämlich *I. setosa*, *laevigata* und *ensata* die zwei ersteren obligatorisch und die dritte fakultativ hygrophil sind. Alle diese Arten sind als die charakteristische Moorbewohner anzunehmen und dürften die Indikator- oder Leitpflanzen der Moore darstellen. Wenn ein Moor verschwindet, gehen die zwei ersteren Arten bald ein (obligatorisch hydrophil), während die dritte, wegen ihrer Widerstandsfähigkeit gegen die Trockenheit, üppig gedeihen kann wie vorher (fakultativ hygrophil).

**218. Über den Einfluss der äusseren Faktoren auf die Grösse und Farbe der Kirschblüten.** (Mit japan. Zfg.). Manabu MIYOSHI. (Bot. Mag. Tôkyô **51**, 1937, 210-211, 2 Tabbl., 396).

Einige Beispiele betreffs der im obigen Titel genannten Tatsache sind in diesem Aufsatz hervorgehoben. Die im Schatten geöffneten Blüten des Kirschbaumes sind zuweilen kleiner und blasser als diejenigen, welche sich im Lichte entwickelt haben. Die im Treibhaus zum Aufblühen gebrachten Blüten sind kleiner als diejenigen, welche im Freien geöffnet sind, usw. Das Studium über Kirschformen muss somit stets im natürlichen Zustand ausgeführt werden.

**219. Studies on the gametophyte of ferns (I). On the prothallia of *Dryopteris varia* O. KUNTZE and their development.** Siduo MOMOSE. (Jour. Japan. Bot. **13**, 1937, 113-120, 4 text-figs.).—(II). **On the prothallia of *Cyrtomium falcatum* (L. fil.) PRESL. and *Rumohra Staundishii* (MOORE) NAKAI.** By the same author. (Ibid. 414-424, 8 text-figs.).

The classification of ferns has hitherto been chiefly based on their sporophyte, and the study of their gametophyte was rather neglected. The author intends to study the prothallia and their development in various ferns and to apply the results of his observations in their natural classification.

The first object of the author's study was *Dryopteris varia*. The development of its prothallia from the spore was studied on the culture on *Sphagnum*. First of all, the development of protonema from the spore was followed. The endospore gives rise first to two cells, of which the lower develops into the rhizoid. In the upper cell few transverse cell-divisions occur successively in acropetal order, and the terminal cell produces a small papilla at its apex which marks the end of acropetal division. The characteristic feature of further development is the formation of the two-sided apical cell at the lateral part of the terminal cell. The mature prothallium is reniform

at its basal part and deeply indented at its upper part. *Dryopteris varia* is not rarely ranked among *Polystichum*, but several characteristics, such as the formation of apical cell at the lateral part of the terminal cell, as above noticed, the fact that the margin of both prothallial wings is wavy and that the marginal cells with glandular processes are protruding out prominently from the margin, etc. are common to the species under discussion as well as several species of *Eudryopteris*. Such facts seem to justify to rank *D. varia* among *Dryopteris*, especially *Eudryopteris*.

The mode of prothallial development of *Cyrtomium falcatum* much resembles that of *D. varia* above mentioned, but there is a conspicuous difference between the two concerning the formation of the apical cell. After some acropetal cell-divisions of the upper endospore cell the terminal cell divides itself into two by a vertical wall; a wall which is perpendicular to the latter is then produced and gives rise to an apical cell at the apex of the protonema in the direction of the axis of growth. *Cyrtomium falcatum* has till very recently been ranked among *Polystichum*. Many characteristics of the gametophyte are common to both genera, but while the prothallium of the latter is narrowly cordate and deeply indented at its apical part, that of the former is broad fan-shaped and very shallowly indented at its apical part.

The mode of prothallial development in *Rumohra Staundishii* is very similar to that in *Cyrtomium falcatum* above recorded. The prothallia of this species accord in several respects with those of *Polystichum* and it is rather difficult to distinguish them clearly.

**220. Mikroskopische Untersuchungen über die Nadi- und die Benzidin-Reaktion in dem Staubfadenhaare von *Tradescantia*.** Takeshi MORI und Toshijiro TANAKA. (Bot. Mag. Tôkyô, **51**, 1937, 302-305, 4, 6).

Die Nadi-Reaktion fällt zunächst nur bei Mikrosomen in der lebenden Staubfadenhaarzelle von *Tradescantia* positiv aus, dann erst nach 30 Min. Stehen lässt sich die ganze Zelle färben, und zwar besonders stark werden die Randteilen des Hyaloplasmas und der Zellwand gefärbt. Die letztere Färbung kann wahrscheinlich auf einer sekundären Adsorption des nach langem Stehen durch Autoxydation gebildeten Farbstoffes an den betreffenden basophilen Teilen beruhen. Bei der auf 52° 1 Std. lang vorerwärmten Zelle sind der Kern und die Mikrosomen gefärbt und die ganze Zelle auch nach 30 Min. gefärbt. In diesem Zusammenhang kann man aus einer Methylenblaufärbung auch auf die basophile Natur des Kerns und der Mikrosomen schliessen. Da die Nadi-Reaktion beim lebenden Kern ganz ausbleibt, kann man annehmen, dass die Dehydrierungsreaktionen der Zelle hauptsächlich im Kern vor sich gehen. CN hemmt die Nadi-Reaktion, trotzdem die sekundäre Farbstoffadsorption nach 30 Min. Stehen unabhängig davon auftritt. Dieser Befund spricht für die Annahme, dass die Nadi-Reaktion beim Kern und Mikrosom nicht auf eine sekundäre Farbstoffadsorption zurückgeführt werden soll.

Die Benzidin-H<sub>2</sub>O<sub>2</sub>-Reaktion tritt in stark essigsaurem Medium nur an den Mikrosomen und an den Chromatinkörnern im Kern auf, nicht aber an den Kernkörperchen, Hyaloplasmen und Vakuolen. Diese Reaktion soll auch nicht auf die sekundäre Adsorption des irgendwo in der Zelle gebildeten Farbstoffes zurückgeführt werden, weil die Farbstoffadsorption an basophilen Teilen im Allgemeinen durch die stark sauren Reaktion gehemmt wird.

Aus den Ergebnissen ist folgendes wahrscheinlich gemacht worden: Indophenol-oxydase und Häminkörper (vielleicht als Cytochrom) seien besonders reichlich in Mikrosomen und Kernen enthalten, die ebenfalls von stärker basophilen Natur sind.

Die Dehydrierungswirkung fällt aber bei Kernen viel stärker als bei Mikrosomen aus.  
T. MORI.

**221. Über die katalytische Oxydation des Cytochroms c durch verschiedene Polyphenolasen sowie durch einige Metallkomplexsalze und Pyridinhämine.** Takeshi MORI, Kazuo OKUNUKI und Eijiro YAKUSHIJI. (Acta Phytchim., **10**, 1937, 81-112).

In bezug auf die Substratspezifität für Cytochrom c, *o*-, *m*-, *p*-Dioxybenzole und Phenylendiamine und die CO- und CN-Hemmbarkeit wurden verschiedene Oxydationskatalysatoren untersucht. Die mit Zellsubstanzen behaftete Indophenoloxydase von Hefe, Sojabohnenbrei und Pollenpräparat ist streng nur auf Cytochrom c und *p*-Phenylendiamin wirksam und stark CN- sowie CO-empfindlich. Die aus *Octaviania*-Pilze und aus Kartoffel-Schalen extrahierte Catecholoxydase zeigte sich nur für Brenzcatechin spezifisch und CN- und CO-empfindlich. Im Gegensatz zu diesen vermag die aus *Lactarius*-Pilze extrahierte Polyphenolase alle geprüften Substrate sehr gut zu oxydieren und zwar wird die Oxydation durch CN stark gehemmt. CO wirkt dagegen auf diese Polyphenolase, analog wie auf die nach YAMAGUCHI aus Herzmuskel oder Hefe extrahierte Indophenoloxydase, kaum hemmend. Fünf Komplexsalze von CO und Ni zeigen je nach der Konstitution der Komplexsalze die von einander weitgehend verschiedene Spezifität, aber dort finden die Oxydation des Cytochroms c und die des *p*-Phenylendiamins, wie bei den anderen Fällen, ganz parallel statt. Pyridinhämin kann auch alle untersuchten Substrate unspezifisch oxydieren und die Wirkung zeigte sich CN- und CO-empfindlich.

Bei der Pyridinhäminkatalyse kann man die Reduktion des Hämins durch die Substrate und die Bildung der CN- und CO-Verbindung des Pyridinhämins in der  $Fe_{III}$ - bzw.  $Fe_{II}$ -Form spektroskopisch verfolgen.

Die Abhängigkeit der Oxydationsgeschwindigkeit vom Sauerstoffdruck zeigte sich bei Pyridinhämin und *Lactarius*oxydase fast linear, dagegen bei Hefe, wie aus der WARBURG'schen Formulierung ersichtlich, hyperbelförmig.

Das oxydierte Cytochrom c kann sowohl durch das Alkoholdehydrase-Co-Dehydrase- (mit Flavoprotein) als auch durch das Laktatdehydrasesystem reduziert werden.

Vier Oxydationskatalysatoren wurden bezüglich Oxydationsgeschwindigkeit an *p*-Phenylendiamin einerseits und am Cytochrom c-Laktatdehydrasesystem andererseits vergleichend untersucht. Die Herzmuskel-, Pollenoxydase und  $[Co Amm_2Cl]Cl_2$  zeigen auf Cytochrom c eine weit stärkere Wirksamkeit als auf *p*-Phenylendiamin, umgekehrt ist das Verhältnis bei der *Lactarius*oxydase.

Aus den Versuchsergebnissen kann man schliessen, dass das folgende Schema für den Mechanismus der Zellatmung von Hefetypus sehr wahrscheinlich ist:

$O_2$ .....Indophenoloxydase-Cytochrom c.....Dehydrasesystem.

T. MORI.

**222. Cyto-genetical studies in *Oryza sativa* L. III. Spontaneous autotetraploid mutants in *Oryza sativa* L.** Toshitaro MORINAGA and Eiji FUKUSHIMA. (Japan. Jour. Bot. **9**, 1937, 71-94, 50 text-figs.).

**223. Phytoplankton from Sagami Bay.** (Japanese). Tomozi MOROBUSE. (Jour. Japan. Bot. **13**, 1937, 104-112, 203-209, 285-292, 375-380, altogether 15 text-figs.).

The following genera, each with a certain number of species, are enumerated:

Diatomaceae: *Melosira* (2), *Paralia*, *Stephanopyxis*, *Skeletonema*, *Thalassiosira*, *Lauderia* (2), *Leptocylindrus*, *Guinardia*, *Dactyliosolen*, *Coscinodiscus* (4), *Arachno-*



*discus*, *Rhizosolenia*(6), *Corethron*, *Bacteriastrum*(3), *Chaetoceras*(13), *Eucampia*, *Hemiaulus*, *Ditylium*, *Triceratium*(4), *Bidulphia*(6), *Rhabdonema*, *Striatella*(2), *Grammatophore*(2), *Licmophora*, *Climacosphenia*, *Synedra*, *Thalassiothrix*(3), *Asterionella*, *Achnanthes*, *Cocconeis*(2), *Navicula*, *Pinnularia*, *Diploneis*, *Pleurosigma*, *Cymbella*(2), *Amphora*(2), *Nitschia*(4), *Campylodiscus*.—Silicoflagellata: *Dictyocha*, *Distephaenus*(4), *Octactis*, *Ebria*.—Peridineae: *Pyrocystis*, *Prorocentrum*, *Dinophysis*(4), *Phalacroma*(3), *Glenodinium*, *Heterocapsa*, *Gonyaulax*(2), *Diplopsalis*(6), *Peridinium*(16), *Pyrophacus*, *Ceratium*(6), *Blepharocysta*(sp.?).

The figures within the brackets denote the number of species in each genus; when no figures are given, 1 species is meant.

**224. Ein Gedanke über die Chromosomenzahlfrage bei Roggen.** (Japanisch.) Masato NAGAO. (*Agric. & Hort.* **12**, 1937, 817-822, 1 Textfig. gruppe).

Nach den Resultaten von den bisher von verschiedenen Autoren ausgeführten Untersuchungen gibt es bei Roggen 7- und 8-chromosomige haploide Zellen. Es ist häufig betont, dass bei den letzteren ein Chromosom durch die Querteilung eines gewissen entstanden ist, obgleich alle Autoren keineswegs dazu beipflichten (vgl. z.B. Japan. *Jour. Bot.* **2**, (45), Nr. 136).

Der Verf., welcher gewisse Roggenmaterialien mit  $2n = 16$  bekommen hat, hat dabei einige Untersuchungen über die Reduktionsteilung von Pollenmutterzellen ausgeführt. Danach hat er bei deren Metaphase ausser 7 bivalenten Chromosomen entweder zwei Univalente oder ein Geminus, welches aus zwei mit ihrer Enden locker verbundenen Univalenten besteht (somit 8 Bivalente im letzteren Fall). Bei der Anaphase erfolgt die Trennung jedes Bivalenten und die Auswanderung der dadurch entstandenen Tochterchromosomen nach den beiden Polen, wie gewöhnlich. Die Univalenten erfahren auch die Längsspaltung und die Spalthälfte wandern nach den Polen aus, und zwar etwas später als bei den Bivalenten, sodass bei der zweiten Metaphase es 7 Dyaden- und 2 Monadenchromosomen gibt. Oft sieht man die folgenden Abweichungen von dieser allgemeinen Regel: 1. nur ein univalentes Chromosom wird längsgespalten und das andere wandert als solches nach irgend einem von beiden Polen aus, und 2. beide univalente Chromosomen erfahren keine Längsspaltung und verteilen sich als solche nach den Polen. Die Resultate solches abweichenden Verhaltens ist die Ausbildung einer Tochterzelle mit 8 Bivalenten und 1 Univalent oder von zwei Tochterzellen, je mit 8 Chromosomen. Bisweilen sieht man eine Tochterzelle mit 8 Chromosomen und die andere mit deren 7, wobei das Verschwinden eines Chromosomes wahrscheinlich ist.

Aus Grund seiner oben angedeuteten Beobachtungen schliesst der Verf., dass die Hypothese der Querteilung des Chromosomes einer erneuerten Untersuchung bedürfen dürfte.

**225. Studies of the growth hormone of plants II. Effect of heteroauxin on the growth of *Helianthus hypocotyl*.** Masayuki NAGAO. (*Sc. Rpts. Tōhoku Imp. Univ.* 4th Ser. **11**, 1937, 447-460, 4 text-figs.).

When heteroauxin-lanolin paste ( $\beta$ -indolyl acetic acid, % of heteroauxin in paste 0, 1/1, 1/2, 1/4, 1/8, 1/16, 1/32) is applied to the cut surface of the cotyledons made by removing their upper halves or to that of the hypocotyl decapitated at about 1 mm below the cotyledons, the elongation of the upper part of the latter is inhibited, though a small acceleration of growth in its middle or lower is discernible. In both cases the remarkable swelling is produced in the hypocotyl.



When heteroauxin is applied to the cut surface of one of the two cotyledons, of which the upper half has been cut off, the hypocotyl shows negative curvature in its middle or lower part.

When the hypocotyl is decapitated at about 5 mm below the cotyledons no inhibition of its elongation is observed, while when the decapitation is practised at about 1 mm below the cotyledons the inhibition takes place, as above mentioned.

On the basis of the facts above recorded the author comes to the conclusion that the inhibition is caused by the excess of the growth substance. When the affected zone contains already its amount quite sufficient for its growth the elongation will be inhibited by the further supply of the growth substance, which will come from the cotyledons or the plumule or even may be produced in the hypocotyl itself. When however its amount is insufficient for the growth, it may be accelerated by the same procedure.

**226. Two new species of *Marattia* from Bonin Islands and a new system proposed for the Marattiales.** (English, Japanese and Latin). Takenoshin NAKAI. (Jour. Japan. Bot. **13**, 1937, 1-14, 3 text-figs.).

Two new species, *Marattia boninensis* and *M. Tuyamae* are described with illustrations.

Though the genera *Danaea* and *Macroglossum* are generally included among the Marattiaceae, they are distinguished from other genera of this family on account of several characteristic features, especially, the embryo provided with the suspensor. The author has created a family *Danaeaceae* which contains the two genera above mentioned, in contrast to the family Marattiaceae containing *Angiopteris*, *Archangiopteris*, *Christensenia*, *Protomarattia*, *Marattia* and *Eupodium*, in all of which the embryo lacks the suspensor.

**227. A new species of Schizaeaceae from Bonin Islands, together with the conspectus of families and genera of schizaeaceous plants.** (Japanese, English, diagnoses in Latin). Takenoshin NAKAI. (Jour. Japan. Bot. **13**, 1937, 139-154, 3 text-figs.).

A plant from the Bonin Islands which has been hitherto called *Schizaea digitata* is not really such. The author calls it by the name *Actinostachys boninensis* sp. nov. and gives its diagnosis. The family Schizaeaceae should properly contain only two genera *Actinostachys* and *Schizaea*, the Lygodiaceae *Lygodium*, *Lygodictyon*, *Gisopteris* and *Odontopteris*, and the Aneimiaceae *Aneimia*, *Anemidictyon*, *Anemiaebotrys*, *Coptophyllum*, *Mohria* and *Trochopteris*. The diagnoses of four families and the key for the determination of the genera contained in each family are given.

**228. Japanese *Hepatica* (I).** (Japanese with Latin diagnoses). Takenoshin NAKAI. (Jour. Japan. Bot. **13**, 1937, 227-243, 13 text-figs.; 305-314, 1 text-fig.).

The key for the identification of Japanese species of the genus *Hepatica* is presented. The European species should be called *Hepatica nobilis* SCHREBER and its var. *japonica* is new. The following new species are described: *Hepatica insularis*, *asiatica* and *Yamatutai*. *H. asiatica* contains f. *acutiloba* and *variegata*.

**229. Notulae ad plantas Asiae Orientalis (I).** (Latin and Japanese). Takenoshin NAKAI. (Jour. Japan. Bot. **13**, 1937, 393-406).

The following new species are recorded: *Astilbe divaricata*, *Aconitum tenuissimus*, *A. pseudoproliferum*, *A. pteropus*.

**230. Plants dedicated to Prof. SHIBATA.** (Japanese with Latin diagnosis). Takenoshin NAKAI. (Bot. Mag. Tôkyô **51**, 1937, 362-366).

Two new plants are described by the author in the commemoration number of Prof. SHIBATA in his honour.

*Shibatheranthis*, a new genus of the Helleboraceae which is the plant hitherto called *Eranthis pinnatifida* FRANCHET, and *Acer Shibatai* sp. nov. Both are described in detail.

**231. Iconographia plantarum Asiae-Oientalis.** Vol. II, Nos. 1-2, 1937. Edited by Takenoshin NAKAI. No. 1, 83-114 pp. and 11 pls., and No. 2, 115-139 pp. and 10 pls.).

The following plants are contained: No. 1 *Sedum boninense*, *Hypericum oliganthum*, *H. senanense*, *Rhododendron boninense*, *Anaphalis viscosissima*, *Eriocaulon parvum*, *Cestichis plicata*, *Vexillabium fissum*, *Trichomanes acranthum*, *Asplenium calcicola*, *Diphyscium Satoi*, *Arisaema limbatum*, *A. japonicum*, *A. monophylla*, *A. koshikiense*, *A. Sugimotoi* f. *integrifolium*, *A. angustatum* f. *typicum*, *A. serratum* var. *ionochlamys*, var. *viridescens*.

The description of the plants just mentioned is due to TUYAMA, KIMURA, SATAKE, MAEKAWA and ITÔ, and that of all species of *Aconitum* to the editor.

**232. A morphological and taxonomical study of Japanese *Microlepia*.** Takenoshin NAKAI and Siduo MOMOSE. (Cytologia, FUJII Jub. Vol. 1937, 360-365, 4 text-fig. groups).

When *Scypholepia* and *Leptolepia* which are usually included among the genus *Microlepia* are eliminated out from the latter, there remain its 9 species, viz. *hirsuta*, *majuscula*, *marginata*, *pilosella*, *platyphylla*, *Speluncae*, *strigosa*, *subtripinnata* and *Wilfordii*. They may be classed into four types, viz. *Microlepia* Sec. *Eumicrolepia*, *Microlepia* Sec. *Davalloides*, *Pilosella*-type and *Microlepia* Sec. *Wilfordia*. The gametophytic study of the junior author shows that the Eu-*Microlepia* type is represented by *M. strigosa*, *Pilosella*-type by *M. pilosella* and *Wilfordia*-type by *M. Wilfordii*. Two new genera are proposed and described, viz. *Fuzifilix* containing *F. pilosella* nob. (= *Microlepia pilosella* MOORE) and *Coptidipteris* containing *C. Wilfordii* (= *Microlepia Wilfordii* MOORE).

**233. Cytological studies in some dioecious plants.** Goichi NAKAJIMA. (Cytologia, FUJII Jub. Vol., 1937, 282-292, 43 text-figs.).

Concerning a certain number of dioecious plants their male individuals were examined with special reference to ex-chromosomes. In some species studied by the author one unequal pair of chromosomes was seen, and it is assumed by him that such plants should belong to XY-type. In one species, *Humulus lupulus* var. *cordifolius* a tetrapartite chromosome was detected, which may be a sex-chromosome of XYY-type. In some other species no chromosomes which may be taken for sex ones were discovered.

**234. Klimatische Erscheinungen der Pflanzen in bezug auf deren Heimat.** (Japanese). Yôzô NAKAJIMA. (Oekolog. Studien **3**, 1937, 206-222).

Japan ist ein vom Süden nach dem Norden ausstreckendes sehr längliches Land, sogar wenn man sich von den extrem-südlichen Formosa- und extrem-nördlichen Sachalien-Inseln absieht, sodass deren verschiedene Länder auf höchst verschiedenen Breitengraden gelagert und dementsprechend ihre klimatische Verhältnisse höchst mannigfaltig sind. Solche Länder müssen den ekotypischen Studien der Vegetation nach dem Muster von TURESSON besonders geeignet sein. Der Verf. hat seine Studien-

materialien aus möglichst verschiedenen nördlichen und südlichen Teilen Japans einschl. Formosa und Sachalien gesammelt und ihre Kulturversuche an seinem Wohnorte Sendai ausgeführt, mit besonderer Beachtung darauf, dass die gleiche Pflanzenarten aus verschiedenen Ursprungsorten unter ganz gleichen äusseren Bedingungen kultiviert sind. Die bei den vom Verf. Versuchen aufgenommenen Pflanzen gehören zu den folgenden Gattungen, nämlich, *Sanguisorba*, *Solidago*, *Patrinia*, *Pennisetum*, *Agrimonia*, *Chenopodium*, *Allium* und *Plantago*. Bei seinen Kulturversuchen hat der Verf. besonders die physiologischen Charaktere berücksichtigt, z.B. Blütenperiode, Ausreifungszeit der Früchte, Zeit des Aussterbens usw. Die aus seinen Kulturexperimenten induzierten allgemeinen Schlüsse stehen wie folgt: Je höher die Breite des Ursprungslandes der untersuchten Pflanzen ist, desto kürzer wird die Dauer der Blütenperiode sein, und je niedriger die erstere ist, desto länger wird die letztere sein. Weiter, die Pflanzen aus höheren Breitengraden sind im allgemeinen in ihrer Höhe kleiner als dieselben aus den niedrigen.

**235. Über das Auftreten des Schwefelkügelchens im Zellinnern von einigen niederen Algen.** (Mit japan. Zfg.). HIROSI NAKAMURA. (Bot. Mag. Tôkyô 51, 1937, 529-533, 4 Textabb., 624-625).

Es gibt eine Anzahl von Cyanophyceen, Diatomeen und Flagellaten, welche in den reichlich  $H_2S$ -haltigen Medien üppig gedeihen können. Der Verf. hat die Untersuchungen ausgeführt, um kennen zu lernen, ob auch bei solchen Organismen die Schwefeltröpfchen im Zellinneren auftreten können, wie es bekanntlich bei den Schwefelbakterien der Fall ist. Als die Untersuchungsmaterialien dienten ihm *Oscillatoria amphibia* und *neglecta*, *Spirulina Jenneri*, *Pinnularia molaris* und *Euglena viridis*. Alle diese Algen wurden in einer gewissen Nährlösung kultiviert, wozu 0,05-0,5% Natriumsulfid hinzugefügt wurde. Dadurch wurde es vor allem festgestellt, dass gar kein schädlicher Effekt auf die untersuchten Organismen nachgewiesen war. Auch wurde bald im Zellinneren das Auftreten von zahlreichen runden stark lichtbrechenden Gebilde beobachtet. Ihre Natur als freie Schwefelkörner wurde dadurch festgestellt, dass durch die Behandlung mit Glycerin oder konz. Salpetersäure die monokline Krystalle daraus entstanden sind. Weiter wird die Verfs. Annahme über die Entstehung dieses Schwefelkörnchens in Hinblick auf die Kohlensäure-Assimilation geschildert.

**236. Über die Photosynthese bei der schwefelfreien Purpurbakterie, *Rhodobacillus palustris*. Beiträge zur Stoffwechselphysiologie der Purpurbakterien. I.** HIROSI NAKAMURA. (Acta Phytochim., 9, 1937, 189-229).—**Über die Kohlensäureassimilation von *Rhodospirillum giganteum* Beiträge zur Stoffwechselphysiologie der Purpurbakterien. II.** Von demselben Verfasser. (Acta Phytochim., 9, 1937, 231-234).—**Über das Vorkommen der Hydrogenlyase in *Rhodobacillus palustris* und über ihre Rolle im Mechanismus der bakteriellen Photosynthese. Beiträge zur Stoffwechselphysiologie der Purpurbakterien III.** Von demselben Verfasser. (Acta Phytochim., 10, 1937-38, 211-218).

Der Assimilations- und Atmungs-gaswechsel wurde mit der manometrischen Methode untersucht. In der I. Mitteilung hat Verf. eine  $O_2$ -Bildung bei bakterieller Photosynthese bestätigt. Meist ist aber die Assimilationsintensität, ( $O_2$ -Bildung) geringer als die Atmung ( $O_2$ -Verbrauch). In Anwesenheit von  $H_2$ -Atmosphäre wird keine  $O_2$ -Bildung beobachtet. Der Mechanismus dieser bakteriellen Photosynthese ist völlig nach SHIBATAS Theorie erklärbar. Eine Reduktion von  $CO_2$  mittels  $H_2$  erfolgt nur im Licht. Die Reduktion von Nitraten oder, Mb wird auf Hydrogenasewirkung

zurückgeführt. Schliesslich wurde die photochemische Wirkung nach WARBURGScher Methode gemessen und gezeigt, dass zur Reduktion eines Moleküles  $\text{CO}_2$  4 Lichtquanten erforderlich sind.

In der II. Mitteilung wird noch das Verhalten von *Rhodospirillum giganteum* geschildert, welches mit Ausnahme kleiner Besonderheiten mit dem des *Rhodobacillus* übereinstimmt.

In der III. Mitteilung wurde das Vorkommen von Hydrogenlyase, die aus Formiat und Glukose  $\text{CO}_2$  und  $\text{H}_2$  abspaltet, in *Rhodobacillus palustris* gefunden, experimentell gezeigt wurde, dass im Licht diese Produkte,  $\text{H}_2$  und  $\text{CO}_2$ , sogleich zur Photosynthese verbraucht werden.

Verf.

**237. Cyto-genetical studies in the genus *Solanum* I. Autopolyploidy of *Solanum nigrum*.** Miyawo NAKAMURA. (Cytologia, Fujii Jub. Vol., 1937, 57-68, 1 pl. and 19 text-figs.).

Final paper of the author's preliminary note published in 1935. (Cf. Japan. Jour. Bot. 9, (16), No. 72).

**238. Double refraction of the chromosomes in paraffin sections.** Takeshi NAKAMURA. (Cytologia, FUJII Jub. Vol. 1937, 482-493, 1 pl. and 1 text-fig. group).

The double refraction of the nuclei and the chromosomes in somatic and meiotic divisions were observed in paraffin sections and the same results were obtained as those reported in the previous paper (KUWADA and NAKAMURA, 1934). The wall tissue cells of the anther in *Tradescantia reflexa*, *Fritillaria japonica* and *Narcissus tazetta*, root-tip cells in *Vicia faba* and *Fritillaria japonica*, and pollen mother cells in *Fritillaria japonica* and *Narcissus tazetta* were employed as materials. In this investigation it was found that for the purpose of demonstrating the double refraction of nuclei and chromosomes alcohol is most suitable as a fixative. Generally elongated nuclei showed a considerably stronger birefringency than those of the spherical shape. The somatic chromosomes were positively birefringent with respect to their length, and the heterotypic chromosomes were negatively so as reported previously (KUWADA and NAKAMURA, 1934). In the homotypic chromosomes in *Fritillaria*, the birefringence was, on the other hand, negative with respect to the chromosome length in diametrical opposition to the case of *Tradescantia reflexa*. This variation in the optical character between the chromosomes of the former plant and the latter is regarded as due to the fact that in the former the chromosomes are of double-coiled structure while in the latter they are of single-coiled. The spindle was observed to be positively birefringent with respect to the long axis. It was also observed in root-tip cells of *Vicia faba* treated with boiling water, that the swollen matrical part of the chromosomes showed a negative birefringence with respect to the length.

Author.

**239. Über den Wechsel des Blutungsdruckes von *Cornus controversa* HEMSL.** Harufusa NAKANO. (Jour. Fac. Sc., Imp. Univ. Tokyo, Sektion III, 5, 1937, 75-193, 45 Textabb.).

In dieser Arbeit beabsichtigt der Verfasser den Wechsel des Blutungsdruckes von *Cornus controversa* hauptsächlich selbstregistrierend durch einen von selbst geplanten Druckmanometer zu untersuchen. Als das Versuchsmaterial standen dabei ein grosser im botanischen Garten der Tokyoer Universität zu Koishikawa wildwachsenden *Cornus*-Baum, daneben auch andere kleinere wildwachsende und topfkultivierte Pflanzen, manchmal einige abgeschnittene Zweige zur Verwendung.



Schon lange vor 1925 studierte Professor M. MIYOSHI den Blutungsdruckwechsel eines grossen oben genannten Baumes ablesend mit einem offenen Quecksilber-Manometer. Vorliegende von 1926 bis 1936 fortgesetzte Untersuchung des Verfassers soll also als eine Kontinuation des Studiums von Prof. MIYOSHI betrachtet werden. Die dabei erhaltenen Resultate lassen sich wie die folgenden zusammenfassen.

1. Es lassen sich zwei Arten des Druckwechsels während der Hauptblutungszeit unterscheiden. Die eine, der jahresperiodische Druckwechsel, kennzeichnet sich durch eine tägliche Druckzunahme unter dem Abschluss der Lichtbeeinflussung; die andere, der tagesperiodische Druckwechsel besonders unter der Lichtbeeinflussung durch das Vorkommen eines Druckmaximums und -minimums.

2. Eine lineale in der Rate von 6.3 cm in 24 Stunden aufsteigende Druckkurve, die in einer mit einer konstanten grossen Luftfeuchtigkeit und mit einer konstanten Luft- und Bodentemperatur verbundenen Schnee-Nacht erschien, darf als ein Kriterium der vor dem Erscheinen des Jahresmaximums vor sich gehenden jahresperiodischen Druckzunahme betrachtet werden. An einem auf kaltes Wetter folgenden Morgen geht eine grössere, an einem auf warmes Wetter folgenden Morgen aber eine geringere Druckzunahme vor sich.

3. Man unterscheidet bei *Cornus* drei Blutungsstadien, wovon das frühere und spätere Stadium einen etwa dem Lufttemperatur parallel gehenden Druckwechsel aufweist. Die Ursache davon scheint sehr wahrscheinlich mit dem verhältnismässig schwachen Wurzeldruck im Zusammenhang zu stehen. Der Fall ist aber ganz anders beim Hauptblutungsstadium, wo der Druckwechsel nicht parallel dem Lufttemperaturwechsel geht. Nun ist es nicht klar, ob der von BOSE bei einem Baum von *Poinciana regia* nach dem Laubfall beobachtete Fall dem früheren oder späteren Stadium des Verfassers entspricht oder phylogenetisch bestimmt ist.

4. Während der Hauptblutungszeit entspricht die tägliche Zunahme der Konzentration des Wurzelblutungssaftes etwa der täglichen Blutungsdruckzunahme; die Konzentration des Stengelblutungssaftes wechselt aber von Tag zu Tag etwa invers proportional der Lufttemperatur der vorangehenden Zeiten. Da die Konzentration des Blutungssaftes der Saftkonzentration der dem Gefäss anliegenden lebenden Zellen entsprechen soll, so bedeutet die grössere Konzentration des ersteren einen entsprechenden grösseren hydraulischen Druck, anders grösseren osmotischen Aussendruck. So wird die tägliche Blutungsdruckzunahme hauptsächlich durch den täglichen Aufstieg des osmotischen Aussendruckes der Wurzel, oder des Wurzeldruckes hervorgerufen, aber durch den schwankenden Wechsel des osmotischen Aussendruckes des Stengels unregelmässig gestaltet.

5. Eine plötzliche Vergrösserung der Konzentration der Nährlösung retardiert den Wurzeldruck, eine allmähliche Vergrösserung derselben aber fördert den genannten Druck, was sehr wahrscheinlich mit dem Eindringen der Salzionen und mit einer regulatorischen Tätigkeit der Wurzel zusammenhängt. So könnte das Eindringen der Wurzel in neue Bodenräume während der Hauptblutungszeit den Wurzeldruckaufstieg hervorrufen. Die mit dem Wurzelwachstum Hand in Hand gehende Auflösung der Reservestärke könnte auch im Zusammenhang mit dem vorhin gesagten Vorgang den Wurzelsaft konzentrierter, und folglich den Wurzeldruck grösser machen.

6. Ausser dem osmotischen Aussendruck kommt noch ein physikalischer, genauer thermischer Aussendruck zustande, der durch die Ein- und Ausstrahlung der Wärme von der Zellwand verursacht wird. Als Wärmequelle seien vor allem die Sonnenstrahlen, aber auch die Luft- und Bodentemperatur genannt. Bei einer im Labo-



ratorium kultivierten Topfpflanze spielen die beiden letzteren Faktoren, bei einem im Freien stehenden Baum aber der erstere Faktor eine grosse Rolle. So zeigt eine Topfpflanze einen mehr dem Lufttemperaturwechsel parallel gehenden Druckverlauf. Wird der Topf erwärmt oder abgekühlt, so verläuft der Druck, konstante Lufttemperatur vorausgesetzt, genau parallel der Bodentemperatur. Die Wirkung des osmotischen Aussendruckes ist bei einer Topfkultur kaum merklich, sodass das Jahresdruckmaximum dort manchmal unter der Zusammenwirkung der Boden- und Lufttemperatur bestimmt wird. Bei einem im Freien stehenden Baum tritt kaum die Wirkung des durch Boden und Lufttemperatur ausgeübten Aussendruckes zutage, sondern diejenige des durch Sonnenbestrahlung ausgeübten stark in den Vordergrund.

7. Um den Einfluss der Sonnenbestrahlung auf den eben gesagten physikalischen Aussendruckwechsel genauer kennen zu lernen, hat der Verfasser zunächst verschiedene Erwärmungs- und Abkühlungsversuch nicht nur mit Topfpflanzen, sondern mit einem abgeschnittenen, abgetöteten Stengelstücke ausgeführt. Hierdurch gelangte der Verfasser zur Überzeugung, dass die durch Wärmeeinstrahlung und -ausstrahlung verursachte Expansion und Kontraktion der Zellwände der an die Gefässe angrenzenden Gewebe die Grundursache davon sind. Die berechnete thermische Expansionsrate eines Stengelstückes entsprach ungefähr dem Wert des beobachteten thermischen Blutungsdruckwechsels. Der eben ausgesprochene Schluss lässt naturgemäss eine merkwürdige Tatsache erwarten, dass nämlich die Gefässwände durch Wärmeeinstrahlung nach Innen gepresst werden, was schon von den Amerikanern MERVIN und LYON hervorgehoben wurde.

8. Die eben erwähnte MERVIN und LYONSche Erscheinung scheint aber auf den ersten Blick mit den Tatsachen, auf welche MACDOUGAL und seine Schüler aufmerksam machten, im Widerspruch zu stehen, dass nämlich die Dicke der Bäume unter dem Einfluss der Wärme schwankend wechselt. Die eigene mit einem MAC DOUGALSchen Dendrograph ausgeführte Untersuchung des Autors zeigt aber, dass der *Cornus*-Baum kaum merkliche Dickenveränderung aufweist. Es scheint ihm also, als ob die mit keiner oder unmerklicher Dickenveränderung versehenen Bäume einen hohen Blutungsdruck aufweisen könnten.

9. Der Druckkurvenverlauf eines grossen wildwachsenden Baumes wurde mit dem Aktinographen an ein und demselben Tag genau verglichen, und danach wurde gefunden, dass die Schwankung des Druckwechsels nicht nur durch vorübergehende Wolken, sondern auch durch die Beschattung von anderen Bäumen und Gebäuden bestimmt ist. Jedenfalls ist eine vorangehende Wärmeeinstrahlung auf den Baume die wichtigste Vorbedingung der heftigen Druckschwankung.

10. Der Beschattungsversuch mit einer Feldpflanze genügt auch, um einen Druckfall darzulegen. Eine künstliche Besprengung der Pflanze mit kaltem Wasser hat auch einen plötzlichen Druckabfall, diejenige mit warmem Wasser jedoch zuerst einen plötzlichen Druckanstieg, später aber einen plötzlichen Abfall zufolge. Damit ist die Abkühlungstätigkeit des Regens, die man öfters aus den Druckkurven ersieht, leicht zu erklären.

11. Eine *Cornus*-Topfkultur mit vorheriger Erwärmung weist durch Wind einen Druckabfall, ohne derartige Vorbehandlung aber keinen solchen auf. Durch Wind ergibt sich bei einem abgeschnittenen Stengelstücke ein steilerer Druckabfall also ein spitzigerer Höcker auf einer Kurve als in ruhiger Luft. Auf einer mit einem Feldbaum erhaltenen Druckkurve zeigt sich aber kaum ein solcher Fall. Die mit zahlreicheren Spitzen und mit spitzigeren Gipfeln versehene an einem klaren, stürmischen

Tage gewonnene Druckkurve kann sich aber mit Recht so deuten lassen, dass die heftig vorbeigehenden Wolken die Grundursache davon bilden.

12. Die Transpiration der unbelaubten *Cornus*-Äste ist sehr unbedeutend, sodass der davon abhängige Druckwechsel kaum merklich sein könnte. Die Wärme-Ein- und Ausstrahlung eines *Cornus*-Astes ist aber sehr bedeutend, woraufhin also ein pulsatorische Druckschwankung vor sich gehen könnte. Die Transpiration der belaubten *Cornus*-Äste ist aber ansehnlich, dass ein starker Druckabfall damit, auch ohne einen nennenswerten Abstieg des Wurzeldruckes möglich ist.

13. Der Blutungsdruck eines *Cornus*-Baumes nimmt nach oben ab. Da die Blutungsströmung im normalen intakten Zustand sehr träge ist, so dürfte eine hydrostatische Formel dort gültig sein. Deshalb hat der Verfasser die folgende Formel für die Geschwindigkeit einer Blutungsströmung abgeleitet.

$$v = \frac{D_u - D_o}{k \cdot h} \quad \begin{array}{l} D_u \dots \text{Druck an einer unteren Stelle des Baumes} \\ D_o \dots \text{,, ,, ,, oberen ,, deren Abstand von der unteren } h \text{ ist} \\ k \dots \text{Eine Konstante} \end{array}$$

Durch einige Versuche hat der Verfasser den Wert von  $v$  und  $\frac{D_u - D_o}{h}$  gewonnen und hierauf den Wert  $k$  berechnet. Zur Zeit der ungewöhnlichen Druckabnahme nimmt der Wert  $\frac{D_u - D_o}{h}$  zu, und im Falle der plötzlichen Druckzunahme aber derselbe ab, und dementsprechend muss der Wert von  $v$  grösser oder kleiner werden.

14. Da die Leitungsgeschwindigkeit eines hydraulischen Druckes enorm ist, so muss irgend eine Druckveränderung an einem oberen Stengelteil momentan nach unten fortgeleitet werden. Somit ist das zeitliche Zusammenfallen eines Druckwechsels an zwei in vertikaler Richtung übereinander gestellten Manometern zu erklären. Natürlich tritt dabei eine abweichende Höhe des Druckwechsels an den beiden Manometern auf. Der Verfasser fand immer einen höheren Druckwechsel am oberen Manometer, wodurch als Entstehungsort eines tagesperiodischen Druckwechsels ein oberer Stengelteil betrachtet werden darf.

Zwei in etwa gleicher Höhe, aber an entgegengesetzten Seiten angesetzte Manometer zeigen gleichen Druckverlauf, aber abweichende Höhen des Druckwechsels. Daraus darf man den Schluss ziehen, dass der ursprüngliche Druckwechsel an verschiedenen oberen Stengelteilen verschieden gross sein könnte. Also kann man verschiedene Arten Blutungsströmungen an verschiedenen Seiten eines Baumes annehmen. Infolge abweichender Höhen des Wurzeldruckes könnte auch eine Differenz der absoluten Druckwerte an verschiedenen Seiten auftreten.

15. Es kommen drei Arten der plötzlichen Druckabnahme vor:

1. Abendliche plötzliche Druckabnahme.
2. Fröhmorgendliche, „sogenannte“ ungewöhnliche.
3. Durch Regen hervorgerufene.

Alle Arten der plötzlichen Druckabnahme sind auf eine einzige einheitliche Ursache, nämlich auf eine Abkühlung der Bäume zurückzuführen. Da der dabei vor sich gehende Druckabfall, wie bei anderen thermischen Druckschwankungen, von der Volumveränderung der Gefässlumina herrührt, so muss derselbe Abfall sich je nach dem Durchmesser der angewendeten Manometer verändern. Der durch den Abkühlungsversuch eines Stengelstückes erhaltene Druckabfall erklärt zur Genüge die Möglichkeit des im Freien beobachteten auffallend grossen Abfallwertes.

Als Entstehungsbedingungen der betreffenden Erscheinung kann man starke Wärmeausstrahlung, tiefe Lufttemperatur, und plötzlich vorkommenden Regen nen-

nen. Ausserdem scheint ein genügend grosser Wurzeldruck eine unerlässlich wichtige Vorbedingung dafür zu sein.

16. Da nach der Ansicht des Autors der am Grunde eines Baumes herrschende Blutungsdruck unter der Mitwirkung sowohl des Wurzeldruckes  $w$ , als auch in der Wurzel oder im oberen Stegelteil entwickelten osmotischen und physikalischen Aussen-druckes ( $Awo$ ,  $Awp$ ,  $Aoo$ ,  $Aop$ ) entsteht, so besteht die folgende Formel zwischen jenen Drücken.

$$Du = \frac{1}{a+1} [Aoo + Aop + (w + Awp)(a+1) - (h+d)k]$$

$$W = Awo, \quad Dw = Awp + W$$

$Du$  = Der Wurzeldruck am Grunde des Stengels.

$k$  = 0.073 cm Hg pro 1 cm Abstand.

$h$  = Der Abstand zwischen dem Baumgrunde und einer oberen Stelle des Stengels.

$d$  = Der Abstand zwischen dem Baumgrunde und einer Stelle der Wurzel.

$a$  = Eine Konstante.

Nach dieser Formel lässt sich die Bedeutung des Tages- und Nacht-Kurve klarstellen.

In der Nacht wechselt wegen des Fehlens der Wärmeeinstrahlung  $Aop$  unmerklich, dagegen  $Aoo + W$  stärker, aber langsam, so dass die Druckkurve während der Hauptblutungszeit stetig langsam ansteigt.

An regenerischen, bzw. Schneetagen finden wir etwa ähnliche Bedingungen wie beim obigen Fall.

An wolkigen und schönen Tagen tritt die Wirkung von  $Aop$  vor allem hervor. Während kurzer Zeitspannen besteht also das folgende Verhalten:

$$\frac{dDu}{dt} = \frac{dAop}{dt}$$

Unter solchen Bedingungen entsteht gewöhnlich das Tagesmaximum und -minimum eines schönen Tages. Als Ausnahmefall kommt es öfters vor, dass  $Aoo$  infolge tiefer Lufttemperatur so stark in den Vordergrund tritt, dass um 6 Uhr ein Tagesmaximum (also der Anfänge der ungewöhnlichen Druckabnahme) entsteht.

17. Die pro Stunde ausfliessende Saftmenge verhält sich etwa proportional dem dabei herrschenden Druck. Die Möglichkeit eines solchen Ausflussmengenwechsels ist auf Grund der bekannten POISEILLESchen, oder mehr etwas modifizierter Formel leicht zu erklären. Wenn das Bohrloch älter wird, so geht jeden Tag ein Abfall der Ausflussmenge vor sich. Nach der experimentellen Konstatierung mehrerer Tatsachen gelangte der Verfasser dazu, den Abfall der Ausflussmenge für einen pathologischen Vorgang zu halten.

Etwa mit dem Abfall der Ausflussmenge hängt das Verlorengehen der pulsatorischen Druckschwankung zusammen. Eine solche Erscheinung bemerkt man öfters unmittelbar nach dem Auftreten einer ungewöhnlichen Druckabnahme, deren Anfangsdruck einem Jahresmaximum entspricht. Das hängt sehr wahrscheinlich teils mit einer gesteigerten Transpiration, grösstenteils aber mit der vorhin erwähnten pathologischen Erscheinung zusammen. Zusammenfassend darf man also den Schluss ziehen, dass das Jahresdruckmaximum, hauptsächlich durch den Wurzeldruck, aber mehr oder weniger deutlich durch eine pathologische Erscheinung bestimmt wird.

Verfasser.

**240. Beziehungen zwischen Artenzahl und Arealgrösse bei zweierlei Wiesengesellschaften Mitteljapans.** Harufusa NAKANO. (Bot. Mag. Tōkyō 51, 1937, 221-230).

Die vorliegende Untersuchung beabsichtigt erstens zu entscheiden, welche der bisher betreffs der Beziehung zwischen Artenzahl und Arealgrösse abgeleiteten Formeln am besten der bei unserer Wiesen beobachteten Artenzahl entspricht, zweitens zu prüfen, ob die Übereinstimmung der beobachteten mit der nach der Wahrscheinlichkeitsformel berechneten Artenzahl nicht oberflächlich ist, und letztens zwei Wiesen-gesellschaften betreffs Artenverteilung auf grösseren Arealen zu vergleichen.

Eine von dem Verfasser zur Untersuchung herangezogene Wiesensoziation befindet sich im Dorf Akigase, unweit von Tokyo, am Flusse Arakawa und darf als *Miscanthus sacchariflorus-Thalictrum simplex* var. *affine*-Soz. nennen. Im Mai 1929 mit Hilfe seiner damaligen Studenten zählte der Verfasser die Artenzahl in verschiedenen grossen Arealen. Auf Grund der damit erhaltenen mittleren Artenzahl in 100 dm<sup>2</sup> (23.4) berechnete der Verfasser die Artenzahl in verschiedenen Arealen und die so erhaltenen Werte wurden mit den beobachteten verglichen. Danach fand der Verfasser, dass ARRHENIUS' Formel für die genannten Soziation besser als ROMELLS passt.

Durch eine peinliche Bearbeitung während des Jahres 1929 zählte der Verfasser mit Hilfe seiner Studenten die Individuenzahl in 1, 4, 9, 16, 25, 36, 49, 64, 81, 100 dm<sup>2</sup> der genannten Soziation und damit wurde die Artenzahl in verschiedenen Arealen nach ARRHENIUS' und KYLINS Wahrscheinlichkeitsformel berechnet.

Durch das Vergleichen der beobachteten und berechneten Artenzahlen geht es deutlich hervor, dass die nach ARRHENIUS' Wahrscheinlichkeitsformel berechneten Artenzahlen den beobachteten etwas näher liegen, als die nach KYLINS Wahrscheinlichkeitsformel berechneten, doch den nach ARRHENIUS' einfacher Formel berechneten an Genauigkeiten weit nachstehen.

Um eine praktisch verwendbare Wahrscheinlichkeitsformel abzuleiten, wird man unbedingt gezwungen, die verschiedenen Individuendichtigkeit mehr oder weniger gleichmässig zu setzen, und dadurch mehr eine sigmoide Kurve sich ergeben zu lassen. Schon mit dem Gedankengang der Wahrscheinlichkeitsrechnung setzen wir eine gleichmässige Dispergierung der Individuen voraus. Aus diesem Grunde ist es schwer, eine völlige Übereinstimmung der gefundenen Artenzahl mit der nach derselben Formel berechneten zu erwarten, da in der Natur Individuen nicht nur gleichmässig, sondern manchmal über- oder unterdispergiert sind. So ist es ohne weiteres klar, dass die Wahrscheinlichkeitsformel nur für eine Gesellschaft mit gleichmässig verteilten Individuen Gültigkeit besitzt.

*Phragmites longivalvis-Carex Thunbergii*-Soz., die unweit der früheren Soziation und auf einer tieferen Wiese liegt weist eine sigmoide Kurve, also einen mehr der abgekürzten Wahrscheinlichkeitskurve entsprechenden Verlauf auf. Als Ursache dieses Verhaltens darf der Verfasser eine reinere Gesellschaft der ersteren hervorheben. Theoretisch lässt sich dabei das Zustandekommen einer Vergrösserung von  $k$  vermuten.  
Verfasser.

**241. On the inheritance of certain grain characters in oats (A preliminary note).**  
Ichizo NISHIYAMA. (Japan. Jour. Gen. **13**, 1937, pp. 63-65).

In a cross between monosomic oats with  $40 + c_s$  ( $c$ -chromosome of *Avena sativa*) and *A. fatua* with  $40 + c_f c_f$  ( $c$ -chromosome of *A. fatua*), as was expected,  $F_1$  hybrids were found to possess  $40 + c_f$  or  $40 + c_s c_f$ . Certain  $F_2$  lines showing  $40 + c_f$  from the former were selected and their  $F_3$  plants were cultivated. Their chromosome number was determined to be  $40$ ,  $40 + c_f$  or  $40 + c_f c_f$ . In the  $40$ -chromosome plants, glumes of all grains are glabrous, but in the others the grains have always hairy



glumes, although the second grains have generally scanty hairs. The hairs are more numerous produced in the presence of two  $c$ , than one  $c$ .

From these results it will be said that the  $c$ -chromosome (*i.e.* probably the gene  $s$  called by other authors) controls the hairy glume of both the first and second grains. And it is especially noted that in contradiction to the result of previous workers, the hairs can be effected without any cooperation of a gene for the hairs on the glume of the first grain, which has its locus on another chromosome. It is further confirmed that the  $s$  links to a gene or genes for certain grain characters ( $c$ ) and this  $c$ - $s$  linkage group corresponds to the so-called  $c$ -chromosome.

Author.

**242. Studies on the longevity of certain fungi under controlled environmental factors.** Yosikazu NISIKADO and Kôzi HIRATA. (Ber. Ôhara Inst. Landw. Forsch. 7, 1937, 535-547).

Sclerotia of *Sclerotinia trifolium*, *S. Libertiana*, *S. minor*, *Sclerotium oryzae*, *Hypochnus Sasakii* and *H. centrifugus* which are produced in pure culture were kept in the incubator at various temperatures from 0° to 35°. They were placed on air-dried straw, sterilized tap-water and brine. The results of the authors' observations were as follows. The sclerotia of *Hypochnus* are in general longer viable than those of *Sclerotinia*. In tap-water their viability is lost much sooner than under air-dried condition. The rise of temperature leads to the shortening of the longevity, especially above 25°C. Many sclerotia immersed in tap-water of 35°C die within one minute, though some may survive there as long as five months.

**243. On *Neocosmospora vasinfecta* SMITH, a causal fungus of seedling-wilt of silk-tree, *Albizia Julibrissin* DURRAZ.** Yosikazu NISIKADO and Kiyû YAMAUTI. (Ber. Ôhara Inst. Landw. Forsch. 7, 1937, 549-556, 3 pls.).—**Temperature relations to the vegetative and reproductive growth and the pathogenicity of *Neocosmospora vasinfecta* SMITH.** By the same authors. (Ibid. 557-572, 1 pl.). (The same subject in Japanese in Agric. Studies 27, 1937, 345-378, 7 pls.).

In many seaside districts of Japan, especially along the coast of Japan Sea, planting is done in sand-dunes to prevent their translation into the crop fields. *Pinus Thunbergii* is generally used for this purpose, but since its growth is not good, *Albizia Julibrissin* is often used for the same purpose, as its growth is much better. Seedlings of this tree are raised in the nursery, and recently they begin to suffer often by the attack of a wilt disease. The authors have studied this disease and found that its causal fungus is *Neocosmospora vasinfecta* which was known hitherto to infect cotton, watermelon and cowpea. Its morphological characters are described in this paper and illustrated.

The fungus was isolated and its pure culture was made. Temperature relations were studied on pure culture. The ascospores begin to germinate at 10-15°C, optimum  $\pm 30^\circ\text{C}$ , even at 38° they are able to germinate though slightly. The temperature for conidia germination is nearly the same as for that of ascospores. Minimum temperature for perithecia formation 10-15°, maximum 32-35°, optimum 27°.

The pathogenicity of this fungus towards the seedlings of *Albizia Julibrissin* was experimentally demonstrated between 10-35°, the attack is severe at  $\pm 25^\circ$ , and somewhat slight below 15°.

Though BUTLER denies its pathogenicity towards cotton the authors' experiments have clearly shown that this fungus is able to infect cotton, watermelon, etc.



**244. Studies on the Japanese mosses of the orders Isobryales and Hookeriales II.** Akira NOGUCHI. (Jour. Sc., Hiroshima Univ., Ser. B., Div. 2, **2**, 1937, 37-56, 3 pls. and 6 text-figs.).

The following new species are described with illustrations: *Ulota morrisonensis*, *Antitrichia formosana*, *Horikawaea* (gen. nov.) *nitida*, *Eriopus spinosus*.

**245. Contributions to the moss flora of Japan and Formosa. VI-VII.** (With Japan. résumé.) Akira NOGUCHI. (Jour. Japan. Bot. **13**, 1937, 86-95, 407-413, altogether 6 text-figs.).

The following new species are described among others: *Heterocladium gracillimum*, *Thuidium lejeuneoides*, *Entodon Maebarae*, *Neodolochomitra* (gen. nov.) *gigantea*, *Homaliodendron undulatum*, *Leskea subacuminata*, *Haplohymenium fragiliforme*, *H. pinnipinnatum*.

**246. Notes on the Japanese ferns (II). Filices japonicae novae e Carl CHRISTENSEN.** (Japanese with Latin diagnoses). Masasuke OGATA. (Jour. Japan. Bot. **13**, 1937, 120-127).

Among others two new Formosan species due to the determination by the Danish botanist CHRISTENSEN are cited: *Elaphoglossum Ogatai* and *lepidopodium*.

**247. Disarticulation of the branches in *Bladhia*.** (With Japan. résumé.) Yudzuru OGURA. (Bot. Mag. Tôkyô **51**, 1937, 168-167, 5 text-figs., 177-178).

The falling off of the branches of *Bladhia Sieboldii* (= *Ardisia Sieboldii*) at their bases, leaving a prominent scar in the trunk, is a very common phenomenon. When one closely observes the branch of this plant it will be found that it is much thickened at its base. The anatomical studies have shown that though the branch has a closed ring of vascular bundles, the latter is widened at the branch base. This is due to the fact that the vascular bundles are separated from each other by the intervention of soft parenchymatous cells between them, which naturally makes its base mechanically feeble. Through the weakness or death of the branch a cleft is formed at the base which is merely due to the separation of cells. The cells of the cleft elongate, and this leads to the formation of the cork-layer. The falling off in such a manner is what the author calls the "disarticulation". In other species of *Bladhia* the different mode of disarticulation was observed.

**248. Untersuchungen über die Atmung und die Dehydrasesysteme von *Aspergillus oryzae*.** (Japanisch m. deutsch Zfg.) Yasuyuki OGURA und Masasi NAGAHISA. (Bot. Mag., Tôkyô **51**, 1937, 597-612).

Der Hyphenpilz, *Aspergillus oryzae*, der unter dauernder Durchlüftung in die Kulturflüssigkeit submers kultiviert wurde, zeigte eine deutliche Indophenolreaktion bei Zusatz des Nadi-Reagens und zugleich, im Vergleich mit der gewöhnlichen Deckenform, eine deutliche Zunahme des Cytochromgehaltes. Die O<sub>2</sub>-Atmung von submerser Form war gegen KCN und CO recht empfindlich, indem die CO-Hemmung durch Licht ein wenig aufgehoben wurde. Unter Anwendung von Methylenblau als Wasserstoffakzeptor wurde die dehydrierende Wirkung von Pilzkörper und dialysiertem Enzymextrakt (mit oder ohne Co-Dehydrase) untersucht. Es war entbehrlich die Anwesenheit der Co-Dehydrase bei Dehydrierung von Bernsteinsäure, Glykolsäure, Glycero-phosphat, Glycerinsäure und Milchsäure. Ferner wurde es beobachtet, dass wenn das BINDSCHEDLER-Grün, dessen Oxydoreduktionspotential höher als das des Methylenblaus ist, als Akzeptor zum Verbrauch kommt, die Dehydrierung von

verschiedenen Zuckerarten (ausgenommen Fruktose) nachzuweisen, in Gegensatz zum Fall bei Methylenblau. Verff.

**249. Über den bakteriellen Abbau der Konjakmannan.** (Japanisch m. deutsch. Zfg.). Torao OHTSUKI. (Bot. Mag. Tôkyô **51**, 1937, 355-362).

Sieben Arten Bakterien wurden auf den Nährböden geimpft, von denen die einzige C-Quelle das gereinigte Konjakmannan war. Die Resultate der Verfs. Beobachtungen waren wie folgt, hauptsächlich nach dem eigenen Worte des Verfs.:

1. Alle Bakterienarten gediehen sehr üppig auf den genannten Nährböden. 2. Das Mannan wurde bald schnell verflüssigt (*Bacillus aroideae*, *B. mesentericus vulgatus*), bald wenig (*Bacillus subtilis*, *mycoides*, *pyoceamus*) oder gar nicht (*B. coli*, *prodigiosus*). 3. Die Verzuckerung hat immer stattgefunden mit wenigen Ausnahmen, obgleich die Mannose nicht nachgewiesen worden ist. Bei den Abbauprobungen mit den Bakterienenzymen wurde es nachgewiesen, dass (1) *B. aroideae*, *mesentericus* und *B. subtilis* das Mannan verflüssigen, und 2. die Verzuckerung bei allen stattfindet und in einigen Fällen die Mannose produziert ist. Weiter aus dem Verflüssigungsprodukt wurde ein reduzierendes Oligosaccharid, wahrscheinlich ein Trisaccharid als ein Azetat ausgetrennt.

**250. Two new species of the Orchidaceae from Ryukyu.** (With Japan. résumé). Jisaburo OHWI. (Acta Phytotax. et Geobot. **6**, 1937, 47-48).

*Goodyera subumiflora* and *Zeuxine Hoshiana*.

**251. A new species of Hypericum.** (With Japan. résumé). Jisaburo OHWI. (Acta Phytotax. et Geobot. **6**, 1937, 48-49).

*Hypericum nokoensis*.

**252. Rhododendron amamiense sp. nov.** (Japanese with Latin diagnosis). Jisaburo OHWI. (Acta Phytotax. et Geobot. **6**, 1937, 49).

**253. Classification of Japanese Trigonotis.** (Japanese and Latin). Jisaburo OHWI. (Acta Phytotax. et Geobot. **6**, 1937, 115-121).

Four sections, viz. Radicantes, Biennes, Elongatae and Micranthae are established. The species contained in each section are enumerated and described.

**254. Plantae novae japonicae IV-V.** Jisaburo OHWI. (Jour. Japan. Bot. **13**, 1937, 332-343, 436-447).

The following new species are described: *Cyperus Yoshinagae*, *Fimbristylis Takamineana*, *Agropyrum Tashiroi*, *Elymus osensis*, *Juncus triflorus*, *Polygonum Tairae*, *Galactia anisopoda*, *Gordonia Shimadae*, *G. Tagawae*, *Ranunculus shinano-alpinus*, *Rhododendron taiwanalpinum*, *Cyrtandra Yaeyamae*, *Lonicera Okamotoana*, *Phaseolus nipponensis*, *P. Nakashimae*, *P. riukiensis*, *Goodyera yaeyamae*, *Microstylis ishigakensis*, *Platanthera amamiana*, *Stereosandra Koidzumiana*, *Fritillaria Koidzumiana*, *mediobractaeum*, *P. quelpaertense*.

**255. A revision of the genus Pseudostellaria.** Jisaburo OHWI. (Japan. Jour. Bot. **9**, 1937, 95-105).

**256. A note on the development of the embryo-sac in Cardiocrinum cordatum.** Kôhei OIKAWA. (Sc. Rpts. Tôhoku Imp. Univ. 4th Ser. **11**, 1937, 303-305, 1 pl. and 1 textfig. group).

The increase of the chromosome number during the mitosis at the chalazal end of the embryo-sac in some liliaceous plants was studied by BAMBICINI and others. The author has made a similar observation on the Japanese Liliaceae, *Lilium auratum* as well as *Cardiocrinum cordatum* (= *Lilium cordatum*). According to the author's observation in the latter plant, where the haploid chromosome number is 12, four nuclei are formed in the embryo-sac after two successive nuclear divisions. Of these one is found in the micropylar region, while the remaining three migrate towards the chalazal region. In the third division one at the micropylar region divides to form two haploid nuclei, while at the chalazal region three nuclear spindles fuse together ( $3n = 36$ ), and two triploid nuclei are formed as the consequence, thus the second four-nucleate stage is reached. The fourth division gives rise to four micropylar haploid and four chalazal triploid nuclei, Three micropylar nuclei form the egg-apparatus, while the remaining one migrates into the middle region of the embryo-sac to fuse with one nucleus coming from the chalazal region, thus forming the secondary embryo-sac nucleus. The remaining three triploid nuclei form together the antipodal apparatus.

**257. Über den Hydrotropismus der Wurzel von *Vicia Faba*.** (Japanisch m. deutsch. Zfg.). Genziro OKA. (Bot. Mag. Tōkyō **51**, 1937, 589-597, 1 Textfig.).

In dem vorliegenden Aufsatz wird das Resultat der Verf. quantitativen Experimente der hydrotropischen Reaktion der Wurzel von *Vicia Faba* geschildert. Die Experimente wurden an den Wurzeln ausgeführt, welche sich in einem Kämmerchen befinden. An einer Seite desselben wurde das mit destilliertem Wasser und an der Gegenseite das mit Schwefelsäure-Wasser durchgetränkte Filterpapier aufgestellt, um damit die Bedingung für hydrotropische Reaktion zu verschaffen. Die positive Krümmung kann erst erfolgen, wenn der relative Feuchtigkeitsgrad über 90% beträgt. Für den Eintritt der Reaktion muss die Feuchtigkeitsdifferenz von zwei Seiten zumindest 0,5% pro cm betragen; das Optimum und das Maximum dafür 3 bzw. 7% pro cm. Durch eine genügende Feuchtigkeitsdifferenz kann man die Reaktion sofort eintreten lassen und die Reaktionszeit kann der Feuchtigkeitsdifferenz entsprechend verkürzt oder verlängert werden.

Die hydrotropische Empfindlichkeit der Wurzel wird auf deren 3 mm Spitzenteil beschränkt, sodass wenn man ihn durch Vaseline oder den Stanniolhut bedeckt, wird gar keine hydrotropische Krümmung stattfinden, sogar unter den dafür besten Bedingungen. Ebenso wenig wenn man durch den Spitzenteil ein dünnes Glimmerplättchen der Länge nach steckt, um die transversale Kontinuität abzuschneiden. Auch wenn nachdem die von der Wurzel abgetrennte Wurzelspitze allein hydrotropisch gereizt wurde, man sie auf die Schnittfläche der dekapitierten Wurzel richtig aufsetzt, wird die hydrotropische Krümmung der letztere erfolgen. Ebenso wenn man aus dem Agarplättchen, worüber die Wurzelspitze vorher einiger Zeit gelegt worden ist, einen Würfel herauschneidet und nachdem man ihn einiger Zeit unter der Feuchtigkeitsdifferenz gehalten hat, ihn auf die Schnittfläche der dekapitierten Wurzel aufsetzt, so wird bald die Krümmung der letztere stattfinden, und zwar nach der Richtung von derjenigen Seite des Würfels, welche nach der feuchteren Seite des Experimentkämmerchens gerichtet war.

**258. Triploidie in *Saxifraga stolonifera* var. *viridifolia* MEERB. und *Inula britannica* subsp. *japonica* KITAM.** Sakuichi OKABE. (Cytologia, Fujii Jub. Bd. 1937, 527-534, 23 Textabb.).

Bei *Saxifraga stolonifera* hat der Verf. 54 Chromosomen nachgewiesen, während bei zwei Varietäten derselben, *viridifolia* und *leuconeura* deren 36 zu beobachten waren. Es ist klar, dass 54 der triploiden und 36 der diploiden Zahl entsprechen. Bei *Inula britannica* subsp. *japonica* hat auch der Verf. eine Form mit der diploiden (= 16) und eine andere mit der triploiden (= 24) Chromosomenzahl nachgewiesen können. Bei allen solchen Pflanzen war eine normale Reduktionsteilung in den Pollenmutterzellen zu beobachten. In der I. Metaphase der triploiden Individuen hat der Verf. einige Trivalente gesehen, was auf ihre Autotriploidie hinweist.

Bei der triploiden *Inula britannica* wurde die Embryosackbildung untersucht und verschiedene Abnormitäten wurden nachgewiesen, z.B. Degeneration des Embryosackes, Verlust der Polarität und Differenzierungen.

**259. On the catalase of *Euryale ferox* SALISB.** (Japanese with English résumé). Yonosuke OKADA. (Bot. Mag. Tôkyô **51**, 1937, 324-332).

By the use of fresh seeds of *Euryale ferox* the variation of the activity of catalase contained therein under various conditions was examined. The results of his experiments in which the half reaction time is taken for the standard of comparison are summarized as follows. Firstly, the dilution of the preparation with buffer solution reduces the catalase activity. Secondly, when the amount of preparation in respect to a certain quantity of  $H_2O_2$  decreases, or on the contrary, the amount of the latter increases in respect to that of the former, the half reaction time is markedly lengthened. Thirdly, too much trituration reduces the activity of catalase.

**260. Über den Gaswechsel der Pollen, I.** Kazuo OKUNUKI. (Acta Phytchim. **9**, 1937, 267-285).

In der vorliegenden Arbeit beschäftigt sich der Verf. mit den Studien des Gaswechsels von verschiedenen Pollen, im Zusammenhang mit deren Auskeimung und dem Wachstum der Pollenschläuche. Die Einflüsse der Ionen, welche schon bei der Auskeimung der Pollen beobachtet wurden, wurden auch bei ihrem Gaswechsel mit einem ähnlichen Resultat bestätigt, aber die Beschleunigungs- oder Hemmungserscheinung bei dem ersteren waren immer deutlicher als bei dem letzteren Fall. Die zugesetzten Zuckerarten wurden von den wachsenden Pollenschläuchen gut veratmet. Die Pollenkörner scheiden die Kohlensäure in Anaerobiose aus, wobei der Äthylalkohol in equimolekularer Menge gebildet wird. Bei den Pollen von *Camellia japonica* wirkte Heteroauxin weder auf die Streckung des Pollenschlauches noch auf die Atmung fördernd.

**261. Über ein neues Enzym Glutaminocarboxylase.** (M. japan. Zfg.). Kazuo OKUNUKI. (Bot. Mag. Tôkyô, **51**, 1937, 275-278 m. 1 Textfig., 402-403).

Ohne Desaminierung werden Glutaminsäure und Pyrrolidincarbonsäure durch ein neues Enzym kräftig decarboxyliert. Diese Enzymwirkung ist stark blausäureempfindlich, aber unabhängig von dem Vorhandensein des Sauerstoffs bzw. Kohlenoxyds. Dieses Enzym befindet sich in Pollen und Zwiebel von *Lilium auratum*, Rübe, weissem Kraut, Rettich, Spinat, Mohrrübe u.a. Das pH-Optimum liegt in der Nähe von pH 6.0.

**262. Periodicity of nuclear division in *Crepis capillaris* WALL.** (Japanese with English résumé). Humihiko ONO. (Bot. Mag. Tôkyô **51**, 1937, 554-559, 2 text-figs.).

Root-tips of 5 pot-plants of *Crepis capillaris* were fixed at the interval of one hour during a day. The number of dividing nuclei was counted in each of the materials



which were sectioned as usual. Through this examination it was ascertained that there is a marked periodicity of nuclear divisions, inasmuch as two marked division periods and consequently two resting periods were observed. Thus, for instance, the interval from 11 o'clock 30 min. to 15 o'clock 30 min. and from 21 o'clock 30 min. to 3 o'clock 30 min. are the first and the second period of marked nuclear division respectively. Further, it may be noticed that the beginning of the division period abounds in the nuclei of early stage, while at the end of the same period many nuclei in their late stage are contained. All these facts are shown graphically.

**263. Intergeneric hybridization in Cichorieae III. Fertility and chromosome variation in  $F_1$  and  $F_2$  progeny of *Paraixeris denticulata* var. *latifolium*.** Humihiko ONO. (Cytologia, FUJII Jub. Vol. 1937, 535-539, 2 fig.-groups).

This paper is the sequel to that published in 1935 concerning an intergeneric hybrid *Paraixeris denticulato-platiphylla* (cf. this Jour. **8**, (72), No. 297). A certain number of  $F_1$  plants were left to open pollination; the fertility was very low, and from 11  $F_1$  plants in all only 46 achenes were obtained which may be due, according to the author, to the genic condition causing the self-sterility of the female plant. The external characters of the  $F_2$  plants as well as their chromosomal constitution were various. In  $F_2$  plants the author could observe the small chromosome from *Paraixeris denticulata* as well the satellited chromosome from *Crepis lanceolata* var. *latifolia*. But the discrimination of other chromosomes was hardly possible.

**264. On sex-chromosome in wild hop.** (Japanese with English résumé). Tomowo ONO. (Bot. Mag. Tôkyô **51**, 1937, 110-115, 15 text-figs.).

The study of pollen mother-cells in male and female plants of *Humulus lupulus* var. *cordifolius* has led the author to the determination of their chromosomal formulae which stand as follows:

$$\begin{array}{lcl}
 & 2n & n \\
 \sigma & 20 = X_1 Y_1 X_2 Y_2 + 16 \text{ --- } \begin{array}{c} Y_1 Y_2 \\ | \\ X_1 X_2 \end{array} + 8\text{II} & \begin{array}{l} Y_1 Y_2 + 8 \\ X_1 X_2 + \end{array} \\
 \varphi & 20 = X_1 X_1 X_2 X_2 + 16 \text{ --- } X_{1\text{II}} + X_{2\text{II}} + 8\text{II} - X_1 X_2 + 8. & 
 \end{array}$$

**265. Zur Kenntnis der orientalischen Pilze I-IV.** (Japanisch). Kendo SAITO. (Zeit. f. Gärungsindust. **15**, 1937, 1-6 m. 2 Textabb., 7-8, 454-456 m. 1 Taf.; **16**, 1938, 15-18 m. 1 Taf.).

Die folgenden Pilze wurden im Orient neu entdeckt. Sie sind beschrieben mit der Berücksichtigung ihrer physiologischen Merkmale.: *Sordaria fimicola*, *Pyronema* sp., *Botrytis dichotoma*, *Botryoconis japonica* sp. nov., *Dactylomyces thermophilus*, *Penicillium funiculosum*, *Scopulariopsis brevicaulis*, *Stachybotrys lobulata*, *Periconia felina*, *Aspergillus nidulans*, *Neurospora sitophila*, *Chaetocladium Brefeldii*, var. *macrosporum*, *Trichosporium* sp., ausserdem eine Bakterienart von unbekanntem Namen, in Schanghai gefunden.

**266. Über die Anwendung der biologischen Reaktion zum Nachweis einiger Schwermetalle von geringen Mengen.** Tetsu SAKAMURA. (M. jap. Zfg.). (Bot. Mag., **51**, SHIBATA Commemoration Number, 1937, 236-241, 398).

Dass das Wachstum, die Konidienbildung usw. bei *Aspergillus niger* mit einigen Schwermetallen in Spuren enge Beziehung haben und das Fehlen irgend eines unentbehrlichen oder wichtigen Schwermetalles entweder kein normales Wachstum



erlaubt oder spezifische Abnormität des Entwicklungszustandes hervorruft. Diese empfindlichen Eigenschaften des Pilzes in Betracht ziehend, wurde versucht, die Wachstumszustände von *Aspergillus niger* als Mittel zum Nachweis der Schwermetalle Fe, Zn, Cu und Mn zu verwenden.

Die Reinigung der Chemikalien, die Kultur usw. geschahen fast ebenso wie in der früheren Arbeit des Verfassers (Journ. Fac. Science, Hokkaido Imp. Univ., Series V, 4, 1936, 99–116).

Zum Zwecke des Adsorptionsverfahrens wurde 0.5% Calciumphosphat als Adsorptionsmittel benutzt. Unter Fe, Zn, Cu und Mn wurde irgend ein Schwermetall eliminiert und wurden die anderen drei je in der Konzentration  $10^{-6}$  mol der Kulturlösung zugesetzt. Diese vier Kulturen und noch eine andere mit allen vier Schwermetallen dienten zur Kontrolle und wurden „A-Kulturreihe“ genannt. Zum Nachweis des einzelnen Schwermetalles wurde die Probelösung jeder A-Kultur hinzugefügt, und diese Kulturen wurden als „B-Kulturreihe“ bezeichnet. Durch den Vergleich jeder A-Kultur mit der entsprechenden B-Kultur wurde die Beurteilung des Vorhandenseins der Schwermetalle ermöglicht. Die Proben wurden von anderen Leuten synthetisch hergestellt, und ihre Bestandteile blieben dem Verfasser zum Ende der Versuche ganz unbekannt.

In den ausgeführten allen sieben Versuchen glückte der Nachweis der einzelnen Schwermetallen fast ohne Fehler. Die vorliegende biologische Methode ist zum Nachweis der Schwermetalle in folgenden Konzentration verwendbar: Fe  $10^{-6}$  mol, Zn  $3 \times 10^{-7}$  mol, Cu  $10^{-7}$  mol, Mn  $10^{-7}$  mol.

Verfasser.

**267. Eine schematische Darstellung der osmotischen Arbeitsleistung und Zustandsgrößen der Pflanzenzelle.** Tetsu SAKAMURA. (Cytologia, FUJII-Jubiläumsband, 1937, 115–134).

Die osmotischen Erscheinungen und Zustandsgrößen der pflanzlichen Zelle wurden übersichtlich graphisch dargestellt. Der Zusammenhang der Konzentration der Aussenlösung mit der Saugkraft der Zelle, der Dehnbarkeit der Zellmembran usw. wurde dadurch leicht begreiflich gemacht.

In einer Figur wird die Konzentration der Aussenlösung  $C_{ex}$  auf die Abszisse und die osmotische Konzentration des Zellsaftes  $C_{en}$  (die Konzentration der gesamten osmotisch wirksamen Substanzen in dem Zellinneren) auf die Ordinate genommen. Am Punkt C ist die Aussenflüssigkeit Wasser, und nach der Pfeilrichtung hin steigt die Konzentration. Bei B sind die Konzentrationen des Zellsaftes und der Aussenlösung gleich, und dabei wird die Zellmembran von beiden Seiten durch keinen Druck beeinflusst, d.h. kein osmotischer Druck herrscht an der Zelle. Dieser osmotische Zustand ist gewöhnlich bei der Grenzplasmolyse vorstellbar, und die Konzentration bei B lässt sich mit  $C_i$  bezeichnen. Da  $AB = BC$  ist, so ist das Viereck ABCD ein Quadrat. Die schräge Linie BD neigt sich sowohl zur Abszisse als zur Ordinate mit Winkel  $45^\circ$ , somit bedeutet sie die Isotonie der Aussen- und Innenlösung. Die Linie BE kann entweder eine Gerade oder eine Kurve sein, was von der Dehnbarkeit der Zellmembran abhängig ist. Die Konzentration, welche mit der Strecke zwischen AD und BE ausgedrückt wird, so z. B.  $a+b$ , ist diejenige des Zellsaftes. Die Strecke zwischen BC und BE, so z.B.  $c$ , bedeutet die Konzentration des Zellsaftes, die infolge des Wassereintritts ausgeglichen wird, wenn die Zelle aus der isotonischen Aussenlösung in eine bestimmte hypotonische Lösung übergeführt wird. Der Wert einer Senkrechten innerhalb  $\triangle ABD$ , so z.B.  $a$ , zeigt den Bruchteil der inneren Konzentration, der stets durch die Aussenlösung äquilibriert wird; sie ist daher gleich der letzteren.

Wenn die Zellmembran zwangslos ausgedehnt werden könnte, würden die Bruchteile des entwickelten osmotischen Drucks meistens zur Arbeitsleistung des Wassertreibens benutzt, und würden die Linien BD und BE zusammenfallen. Bei der pflanzlichen Zelle ist dies aber tatsächlich nicht der Fall; die Membranausdehnung ist mehr oder weniger stark beschränkt. Im Gleichgewichtszustand ist die Konzentration des Zellsaftes immer höher als diejenige der Aussenlösung, nur mit Ausnahme der plasmolysierten Zellen. Ein Bruchteil der osmotischen Konzentration nimmt an der Entwicklung des aktiven osmotischen Drucks teil, der an einer pflanzlichen Zelle gewöhnlich zweierlei Dienste leistet. 1. Die ausgedehnte Membran erwirkt die nach innen wirkende elastische Kraft d.h. den „Wanddruck“, während innerhalb der Zelle demgegenüber der osmotische Druck d.h. der „Turgordruck“ steht. Beide Druckarten sind gleichwertig und stehen miteinander im Gleichgewichtszustand. Sie entsprechen der Konzentration zwischen den Linien BD und BE nämlich  $C_{en}-C_{ex}$ , so z.B. b. Der Turgordruck kommt erst infolge der Membranausdehnung vor, aber er ist nicht mehr fähig, weitere Arbeit zu leisten, soweit die Dehnbarkeit der Membran unveränderlich bleibt. 2. Andererseits dient der osmotische Druck auch zum Wassertreiben. Wenn der Druck in der Konzentration relativ ausgedrückt wird, beträgt er diejenige zwischen den Linien BE und BC, so z.B. c. Auch dieser Bruchteil des osmotischen Drucks ist in arbeitsunfähigen Zustand übergegangen. Die Summe dieser Bruchteile b+c, welche schon Arbeit geleistet haben, entspricht dem gesamten osmotischen Druck, der augenblicklich auftritt, wenn die Zelle aus der isotonischen Lösung in die Lösung von  $C_{ex}$  übergeführt wird. Wenn die Zellmembran stark straff ist und keine Dehnbarkeit hat, so bemerkt man keine Volumzunahme, und wird der der Konzentration b+c entsprechende osmotische Druck unveränderlich erhalten. Wird solche Zelle ins Wasser übergeführt, entwickelt sich osmotischer Druck  $C_i RT$  Atm., ohne spätere Veränderung auszuführen. Auch falls die Volumzunahme einer Zelle trotz ihrer genügend hohen Dehnbarkeit durch den gegenseitigen Druck der benachbarten Zellen verhindert wird, entsteht der Turgordruck dadurch.

Die osmotische Konzentration zwischen BE und BC, so z.B. c, ist gleich dem Wert  $C_i - C_{ex}$ . Wird die mit der dehnbaren Membran versehene Zelle ins Wasser übergeführt, wo  $a = 0$  ist, erreichen c und b die maximalen Werte EC. Eine Zelle ist jetzt wassergesättigt und nicht mehr fähig, Wasser einzusaugen. Die Konzentration in diesem extremen Zustand ist der einer bestimmten Zelle eigentümliche Wert und bedeutet die Grenze der Dehnbarkeit der Membran und gleichzeitig den Widerstand, der durch die Zellmembran gegen den inneren osmotischen Druck stets beibehalten wird. Wir möchten die Saugkraft der Zelle auch hier schematisch darstellen. Die Saugkraft des Zellinhaltes wird durch eine Gleichung

$$S_i = (a+b) RT$$

dargestellt, wo  $S_i$  gleich dem osmotischen Wert des Zellsaftes ist, dessen Konzentration  $a+b$  beträgt. Der Wanddruck W ist gleichwertig mit dem Turgordruck, der in diesem Falle mit b bezeichnet werden kann, also

$$W = b RT.$$

Setzen wir diese Werte in die Saugkraftformel ( $S_z = S_i - W$ ) ein, so lässt sich erhalten

$$\begin{aligned} S_z &= (a+b-b) RT \\ &= a RT. \end{aligned}$$

Die der Saugkraft der Zelle entsprechende osmotische Konzentration a ist also gleich derjenigen der Aussenlösung, wenn der osmotische Gleichgewichtszustand zwischen der Aussen- und Innenlösung erreicht wird. Verfasser.

**268. Beobachtungen über japanische Moosflora XIII, XIVa-b.** (M. japan. Zfg.) Kyuichi SAKURAI. (Bot. Mag. Tôkyô **51**, 1937, 8-14 m. 6 Textabb., 31-32, 103-109 m. 7 Textabb., 133-141 m. 6 Textabb., 173-175).

Die folgenden neuen Arten sind diagnostiziert und abgebildet: *Fissidens tokioensis*, *Bryum rubridens*, *Dicranella kiushiana*, *Rhynchostegium percapillatum*, *Rhacomitrium bandaiense*, *R. nipponicum*, *R. papillosum*, *R. hedwigoides*, *R. formosicum*, *R. yakushimensis*, *R. Sakuraii*.

Ein Schlüssel zur Bestimmung von japanischen *Rhacomitrium*-arten (28 Arten) ist dargeboten.

**269. Species novae eriocaulacearum japonicarum** (With Japan. résumé). Yosiusuke SATAKE. (Bot. Mag. Tôkyô **51**, 1937, 285-291, 3 text-figs., 403).

The following three new species are described with illustrations: *Eriocaulon piliformum*, *E. Zyotani* and *E. hondoensis*. Further, the following two new varieties are described: *E. hondoense* var. *pilosa* and *stellatum*.

**270. Analysis of karyotypes in *Leucojum*.** (Japanese with English résumé). Dyûhei SATÔ. (Bot. Mag. Tôkyô **51**, 1937, 59-63, 6 text-figs.).

*Leucojum vernum*, its var. *carrathicum* and *L. aestivum* contain each 22 somatic chromosomes which may be classified into one pair of V-shaped ones with median constriction and four other types with subterminal constriction, viz., one pair of j- and satellited T-chromosomes and four pairs of each of i (median)- and S (short)-chromosomes. In *L. autumnale* 14 somatic chromosomes are composed of one pair of V-shaped ones (which are homologous to those in other species), one pair of j- and T-chromosomes, and four pairs of V'-chromosomes exclusively found in this species and which, according to the author, may have been derived by the fusion, or more probably, by the translocation between 1 i- and S-chromosome.

**271. Polymorphism of karyotypes in *Galanthus* with special reference to the SAT-chromosome.** (With Japanese résumé). Dyûhei SATÔ. (Bot. Mag. Tôkyô **51**, 1937, 242-250, 19 text-figs.).

The karyotype of *Galanthus nivalis* may generally be represented by the formula  $2n=24=4L+14M+6S$  (L long, M median, S short), but the author has found in the same species the plant containing  $2n=25$ , where  $M=15$ . 2, 3 and 4 heteromorphic SAT-chromosomes were there observed. In *G. Elwesii*, besides the individuals with  $2n=24$  there were found the tetraploid ( $2n=48$ ), and 2, 3 and 4 SAT-chromosomes were seen.

HEITZ thinks that the strand connecting the SAT-chromosome and the satellite rather than the chromatin material plays the important rôle in the nucleolar formation. On the contrary, MCCLINTOCK and FERNANDES think that the so-called "nucleolar-organizing body" (MCCLINTOCK) or "région nucléogénique" (FERNANDES) which consists of deeply staining heterochromatin is chiefly concerned in the nucleolar formation; they think that the connecting strand itself is merely the secondary product and may be dispensed with in this process. The author's observation on *Galanthus* lends support to the opinion of the two latter authors: he could observe some satellited chromosome lacking the connecting strand though it is apparently concerned in the nucleolar formation.

**272. Karyotype alteration and phylogeny I. Analysis of karyotypes in Aloineae with special reference to the SAT-chromosome.** Dyûhei SATÔ. (Cytologia, FUJII Jub. Vol. 1937, 80-95, 43 text-figs.).

Forty-eight species and varieties as well as three hybrids in Aloineae, including the genera *Aloe*, *Gasteria* and *Haworthia* were studied in reference to their karyotypes from the view point of their alteration. All these species were generally diploids ( $2n=14$ ) with the formula  $4L+3S$  with some exceptions (i.e. tetraploid *G. maculata*,  $2n=28$ , hexaploid *H. Reinwardtii* and *tesselata*,  $2n=42$ ). The karyotypes under discussion are assumed by the author to have been derived by their alteration, as elimination and translation of satellite and subsequent hybridizations. In *Gasteria* and *Haworthia* there are two pairs of long satellited chromosomes, while in *Aloe* there are various combinations of SAT-chromosomes. The hypothesis of HEITZ on SAT-chromosomes was supported by the author's observations, inasmuch as the number of nucleoli was found to correspond to that of the SAT-chromosomes in telophase.

**273. Notes on the lichen genus *Phyllicum*.** (With Japanese résumé). Masami SATÔ. (Jour. Japan. Bot. **13**, 1937, 292-298, 4 text-figs.).

A key for the determination of the species of the genus *Phyllicum* is first given, and the following species are enumerated or described with synonyms: *P. Demangeonii*, *japonicum*, and *microphyllum*. A map indicating the distribution of *P. japonicum* and *microphyllum* is also given.

**274. Studies on the change of sex expression in ramie (*Boehmeria nivea* HOOK. et ARN.).** (Japanese with English résumé). Tsunetoshi SHIBUYA. (Jour. Soc. Trop. Agric. **9**, 1937, 214-225, 2 text-figs.).

*Boehmeria nivea* is generally known as a monoecious plant with female inflorescences in the leaf-axils of the upper part of stem and male ones in those of its lower part. The author could observe the development of unisexual plants under natural as well as certain experimental conditions.

His experimental field in Formosa was divided into twelve plots, and beginning with May 1932 the plants in each were harvested every month successively and examined respecting their sex expression. The experiment was continued till April 1933. It was definitely ascertained that the plants harvested in May-June, which therefore had grown during the long daylight period ( $\pm 13-13.5$  hours per day in Formosa) are typically monoecious, male and female inflorescences being almost equal in number. In those harvested July-September, when the daylight duration is shorter than in May-June ( $\pm 12-13$  hours per day) the inflorescences with both male and female flowers (bisporangiate) are developed. The ratio,  $\frac{\sigma}{\varphi}$  inflorescences becomes gradually smaller until October (daylight duration  $\pm 11\frac{1}{2}$ ), when plants bear exclusively female inflorescences.

Besides the observation under natural condition just stated, experiments where the daylight duration was artificially controlled were performed, and the author was able to produce at his will any of monoecious, male and female plants. Pure male plants were developed when the daylight duration was prolonged to more than 14 hours per day. The experiments just mentioned confirm perfectly the author's observation on sex expression under natural conditions which are mentioned above.

Further, the relation between the sex expression and the C/N ratio was experimentally studied. It was proven that the greater or the smaller this ratio, the more numerous the male or the female inflorescences respectively. The greater C/N corresponds therefore to the longer and the smaller C/N to the shorter daylight duration. It is quite clear that the duration of daylight is closely correlated with photosynthesis



and consequently the food supply (carbohydrates, especially sugar) with the mode of sex expression.

**275. An experimental study of the abnormal nuclear and cell divisions in living cells.** Michio SHIGENAGA. (Cytologia, FUJII Jub. Vol. 1937, 464-478, 2 pls., 1 text fig.-group).

For experiments young living petal cells of *Tradescantia reflexa* were used. They were treated at first by chloral hydrate, nicotine, caffeine, ethyl alcohol, chloroform as well as the hypertonic solution of saccharose, and then by a hypotonic solution or water. The result was the formation of di-diploid nuclei or the binucleate cell without or with an incomplete septum. The abnormal process just referred to is due to the dehydration followed by the hydration, so that when the dehydration only takes place (for instance, simply the treatment by hypertonic solution) the telophasic chromosomes are not unravelled, and the unravelling takes place after the treatment by a hypotonic solution. It is concluded that the dehydration leads to the inhibition of chromosome migration and that of the cell-wall formation.

**276. Studies on the wound infection of the rice plant by *Piricularia oryzae*.** (Japanese with English résumé). Shoichi SHIMADA. (Ann. Phytopath. Soc. Japan 6, 1937, 307-318).

The rice plants wounded in various ways were atomized with the suspension of conidia of *Piricularia oryzae*. After a certain time the number of diseased patches on leaves was counted. The leaves filed at their surface, bent at the base of blade, or cut off at their midrib show always more numerous diseased patches than in the control. Poor nutrition leads to the increase of the patch number. Also the leaves which were violently shaken before inoculation are affected more heavily than the control.

From all above stated it is clear that the cuticle plays an important rôle in making the plant resistant against the invasion of *Piricularia*.

**277. Infektionsweise der Blätter der Reispflanzen durch *Piricularia oryzae*.** (Japanisch). Shoichi SHIMADA. (Agric. & Hort. 12, 1937, 1106-1108, 1 Textabb.).

Früher wurde es im allgemeinen angenommen, dass bei *Piricularia oryzae* die Infektion von Reisblättern durch deren Spaltöffnungen stattfindet. Die neueren Studien haben aber gezeigt, dass es keineswegs der Fall ist, und dass die Infektion durch die Oberhautkutikula, besonders von den Schliess- und Nebenzellen geschieht. Die auf die Blattoberfläche keimenden Konidien bilden die Haftorgane aus und die von den letzteren ausgebildeten feinen Infektionsfäden dringen zu das Zellinnern ein, und zwar durch die Oberhautkutikula. Die Haftorgane können auf die Blattfläche überall ausgebildet werden; sie können nicht nur auf die Blätter der Reispflanzen, sondern auf diejenigen anderer Pflanzen, woran der Pilz nicht parasitieren kann, ja sogar auf die Glasscheibe entstehen. Die Ausbildung der Haftorgane verursacht nicht immer die Infektion. Es wurde weiter festgestellt, dass die verwundeten Blätter zur bedeutenden Zunahme der Infektion führt.

**278. Chromosomes of the pollen mother-cells in *Trillium kamtschaticum* in the saccharose solution.** (Japanese). Kyojiro SHIMAKURA. (Japan. Jour. Gen. 19, 1937, 19-20.).

The author has studied the living pollen mother-cells of *Trillium kamtschaticum* by placing them in the 6-7% saccharose solution. Not only are then the individual chromosomes clearly visible during the whole time extending between the first prophase and first anaphase, but also their internal structure is distinctly visible, especially



towards the end of the first anaphase. In general the chromosomes swell up easily even by slight mechanical or osmotic injuries on account of the change of the semi-permeability of plasmoderma, but those of *Trillium kamschaticum* are pretty resistant in this respect.

**279. The chromonemata observed in the fresh pollen mother-cells of *Trillium kamschaticum* PALL. mounted with saccharose solution.** Kyojiro SHIMAKURA. (Cytologia, FUJII Jub. Vol. 1937, 256-261, 1 pl.).

The author has observed the pollen mother-cells of *Trillium kamschaticum* in fresh state by imbedding them in anthral slime mixed up with 6-7 % solution of saccharose (prophase I-anaphase I). Though the cell-division was inhibited after this preparation the chromosomes were clearly visible except in earlier prophase I. By this procedure the internal structure could be examined in fresh state, and the double coiling of chromonemata was clearly revealed. Besides, the indications for the existence of double coiled twin chromonemata in a single major spiral or a monad at metaphase I and anaphase I were ascertained.

**280. On the spermatozoid of *Ginkgo biloba*.** Tamaki SHIMAMURA. (Cytologia, FUJII Jub. Vol. 1937, 416-423, 2 pls. and 3 text-figs.).

In *Ginkgo biloba*, between the two spermatozoids derived from one body-cell of the pollen tube there is no limiting cell-wall. The spermatozoids escape out from the pollen tube either gradually or suddenly, and in either case it is clearly seen that their body is very soft and elastic. At the time of fertilization the entire spermatozoid is found within the receptive cavity of the archegonium, which shows that it has passed quite uninjured through the narrow canal between the neck cells, and which confirms the softness and elasticity of its body just indicated.

**281. Über eine triploide Pflanze von *Chrysanthemum*.** Naomasa SHIMOTOMAI. (Cytologia, FUJII Jub. Bd. 1937, 551-552, 2 Textabb.).

In den Wurzelspitzenzellen von *Chrysanthemum frutescens* sieht man  $27 = 3 \times 9$  Chromosomen (9 ist die Chromosomen-Grundzahl bei *Chrysanthemum*). Die Trivalenten sind oft gesehen bei der Meiose der PMZ, was auf die Triploidie der in Rede stehenden *Chrysanthemum*art hindeutet.

Eine andere Art, *C. filifolius* aus den kanarischen Inseln enthält  $n = 9$ , wobei die Meiose ganz regelmässig verläuft.

**282. An experimental study on the structure of living nuclei in the resting stage.** Namio SHINKE. (Cytologia, FUJII Jub. Vol. 1937, 449-463, 2 pls.).

Healthy living nuclei look variously in natural state as well as after their hydration or dehydration by hypo- or the hypertonic solution respectively. In those nuclei, which the author calls Type I they appear to be quite homogeneous in natural state and remain so even after the treatment by the hypo- or hypertonic solution. The nuclei of Type II are quite homogeneous in natural state just as in those of Type I, but here the chromonemata are revealed by the dehydration with a hypertonic solution of a certain concentration, though this structure becomes obscure by the treatment with a more concentrated solution. In the nuclei of Type III (incl. salivary gland cells of the *Chironomus* larvae) their heterogeneous structure is visible even in natural state. By treating them with a hypotonic solution the chromosomes swell up, and the chromatic bands appear as the rows of granules; this structure disappears however by further hydration, and reappears by dehydration.

The hydration and dehydration experiments on the guard-cells nuclei of stomata

in various plants show the changes quite similar to those which are observed in natural state during the opening and closing of stomata. The latter process is, as well known, due to the change in the osmotic pressure of guard-cells.

The net-knots (chromocentres) which are seen sometimes in living nuclei can be transformed into a mass of uncoiled chromonemata, showing that they are the chromosomes in heteropycnosis or their aggregates.

**283. A new species of *Mephitidia* from the laurisylvie in North Taiwan.** (Japanese with Latin diagnosis). SIMIZU-Hideo. (Jour. Japan. Bot. **13**, 1937, 271-273, 1 text-figs.-group),

*Mephitidia nebulosa* sp. nov. is described.

**284. Cytological observations on a sterile form of *Allium angulosum* L.** (Japanese with English résumé). Yosito SINOTÔ. (Rpt. from Soc. Adv. Sc. Japan **11**, 1936, 78-80, 1 figs.-group).

The pollen development in a sterile form of *Allium angulosum* was studied. Meiotic irregularities were observed both in the first and second maturation divisions. Lagging chromosomes were seen which as such or as fragments remain in pollen grains. In young pollen grains about 12 chromosomes and in giant ones which are sometimes formed about 24 chromosomes were counted. The sterile form under discussion seems to be a triploid, where  $2n = 24$ .

**285. On the germination experiments of pollen in solanaceous crops.** (Japanese). Makoto SISA. (Japan. Jour. Gen. **13**, 1937, 43-46),

Observations and experiments were executed on four Solanaceae, viz. tomato, egg-plant, red pepper and *Petunia*.

Among various individual facts mentioned in this paper some will be cited below. Reserve starch grains are not found in pollen grains of tomato and egg-plant, but they are abundant in young ones of red pepper and *Petunia*. The rate of sterile pollen amounts to 3% in the two former, 8% in red pepper and 10% in *Petunia*. In tomato and *Petunia* the best germination of pollen grains takes place in 4/10 m cane-sugar solution, in egg plant in 5/10 m and in red pepper in 3/10 m. The optimum pH of the germination bed is 5.5 in tomato and egg-plant, 5.2 in red pepper and 6.4 in *Petunia*. The shortest pollen-tube was seen in red pepper ( $\pm 36.07\mu$ ), next comes that of tomato ( $\pm 48.47\mu$ ); that of the egg-plant is longer ( $\pm 137.15\mu$ ), and that of *Petunia* is still longer ( $\pm 232.10\mu$ ). In these four species the longest pollen-tube is not necessarily seen in the largest pollen grain. The order of the pollen-tube length corresponds to the style length, though these two quantitative characters are not strictly proportional.

When two kinds of pollen grains are sown in the same agar nutrient medium the germination rate of pollen either changes or not at all. Thus, for instance, that of egg-plant pollen increases considerably (38% by itself and 75% when sown together with that of red pepper), while that of red pepper pollen remains unchanged through this procedure and that of *Petunia* decreases slightly, etc.

The addition of ascorbic acid, insulin or adrenalin, pollinia of *Cattleya* (hormone) to the nutrient medium does not lead generally to the raising of the germination rate of pollen grains, except in egg-plant and red pepper, where such was caused by the addition of *Cattleya* pollinia.

**286. A list of chromosome numbers in angiospermous plants III.** (With Japanese résumé). Toranosuke SUGIURA. (Bot. Mag. Tôkyô **51**, 1927, 425-426, 615).

The n chromosome numbers of 46 species belonging to 21 families and 30 genera of angiosperms are shown in a table. In these plants the division of PMC takes place according to the furrowing mode.

**287. On the mature pollen grains in angiosperms.** (With Japanese résumé). Nobuhide SUITA. (Bot. Mag. Tôkyô **51**, 1937, 524-530 with 1 pl., 623-624).

According to the results of the author's cytological observations on a certain number of angiosperms the droplets-sheath (so called, because it consists of many lipid droplets distributed in the cytoplasm) has been found around the generative nucleus of six monocotyledons and three dicotyledons. The quantity of thymonucleic acid, as ascertained by the FEULGEN'S reaction, is generally abundant in the generative nucleus. In the vegetative nucleus this quantity is various in different species and does not go parallel to the degree of its transformation in shape.

**288. *Monachosorum* and *Ptilopteris*.** Motozi TAGAWA. (Japan. Jour. Bot. **9**, 1937, 107-120, 12 text-figs.).

**289. The genus *Lindsaya* in Japan.** (With Japanese résumé). Motozi TAGAWA. (Acta Phytotax. et Geobot. **6**, 1937, 24-41, 4 text-fig.-groups).

After the introduction a key for the determination of Japanese species of *Lindsaya* is given. Among 10 species cited the following are new: *L. yueyamensis* and *commixis*.

**290. *Spicilegium pteridographiae Asiae Orientalis* 13.** (With Japanese résumé). Motozi TAGAWA. (Acta Phytotax. et Geobot. **6**, 1937, 89-100).

The following are new species: *Dryopteris ensifera*, *Polystichum rigens*, *Bolbitis formosana*, *B. Koidzumii*, *Athyrium yakusimense*.

**291. The influence of the temperature of the culture water on the water absorption by the root and on the stomatal aperture.** Takashi TAGAWA. (Jour. Fac. Agric. Hokkaido Imp. Univ., Sapporo **39**, 1937, 271-293, 13 tables and 8 graphs).

The author has made the experiment on the water-culture of the seedlings of *Phaseolus vulgare* in order to study the variation of water absorption by root and that of the stomatal aperture due to the change of the temperature of culture water, when the other factors, such as atmospheric temperature and humidity, light intensity remain constant. The results were as follows. Between 0-30°C of culture water the rise of water temperature leads to the gradual increment of water absorption by root. When the latter is kept in ice-water of 0°C the stomata open widely notwithstanding the flaccid state of the plant body due to the decrease of water absorption. When the temperature rises the stomata begin to close gradually till 20°C, and upwards 20° to 30° the stomata begin to open, and at the same time the degree of water absorption rises gradually. On the basis of his experimental results the author thinks that the cold injury is due at least in some sense to the disturbance of the water balance rather than to the direct influence of coldness itself.

**292. Contributions to the morphology of *Sciadopitys verticillata*.** Masato TAHARA. (Cytologia, FUJII Jub. Vol. 1937, 14-19, 11 text-figs.).

The studies of LAWSON on the gametophyte and embryo of *Sciadopitys verticillata* was published in 1910. The results of observation of the present author concerning the same plant differ considerably from those of LAWSON. The nucleus of the body-cell in the pollen-tube is situated near its extremity and its division gives rise to two cells which differ eminently in size as well as structure from each other, the smaller

one soon disorganizing. The division giving rise to the ventral canal nucleus and the egg nucleus takes place in the central cell of the archegonium. In the anaphase of this nuclear division the inner pole contains the V-shaped chromosomes compactly arranged, while in the outer pole they are loosely arranged and lie almost in a plane similar to those in the metaphase. The latter nucleus soon disorganises. Since thus this nuclear division is not followed by the cell-division, no ventral canal cell is formed, as in the other Taxodiaceae. The chromosome number is 10 in this case. Five successive nuclear divisions follow the fertilization and give rise to 32 free nuclei, and then the cell-wall formation begins to take place.

It is remarkable, according to the author, that in several respects the gametophyte of *Sc. verticillata* resembles that of Abietaceae rather than of the other Taxodiaceae.

**293. Spiral structure of chromosomes in pollen mother-cells in *Hosta Sieboldiana* ENGL.** Noboru TAKAMINE. (Cytologia, FUJII Jub. Vol. 1937, 159-161, 1 pl.).

The doubly coiled spiral structure was observed in the chromosomes of *Hosta Sieboldiana* in meta- and telophase. During the stage passing from the heterotypic telophase to the interkinesis the major spirals were unravelled while in the interkinesis itself simply the minor spirals were observable. In the homotypic stage simply the single coiled spiral structure was observed.

**294. Unterschied der japanischen Gerstenrassen, welcher durch die Behandlung ihrer Samenkörner mit Karbolsäure, Schwefelsäure oder Aetzkalklösung nachgewiesen werden kann.** (Japanisch). Sigemiti TAKASUGI. (Agric. & Hort. 12, 1937, 1101-1105).

Die im vorliegenden Aufsatz geschilderten Farbenreaktionen der Samenkörner verschiedener Gerstenrassen haben das praktische Interesse, insofern als man sie unterscheiden kann, wenn bloss ihre Samenkörner zur Verfügung stehen.

Für diesen Zweck wird zuerst zu den Samenkörnern verschiedener Rassen der Gerste, welche während ungefähr 15 Stunden im destillierten Wasser geblieben sind, 2% Karbolsäure soweit hinzugefügt, dass 1/3 Teil jedes Kornes dadurch bedeckt werden kann. Die Beobachtung der Farbenreaktion geschieht nach  $\pm 20$  Stunden. Die Farbenreaktion ist nach den Rassen verschieden: keine Reaktion, braun oder stark braun gefärbt. Die Rücken- und Bauchseite jedes Kornes können in verschiedener Weise reagieren.

Die Resultate der Beobachtung des Verfs. an verschiedenen Rassen japanischer Gerste sind in einer Tabelle angezeigt, wofür auf das Original verwiesen sei.

5% Schwefelsäure und die Aetzkalklösung gewisser Konzentration können für den gleichen Zweck verwendet werden.

**295. Studies on the succession of plants found in newly reclaimed land by the seashore in the vicinity of Hukuoka.** (Japanese with English résumé). Makoto TAKE-NOUCHI. (Bul. Sc. Fak. Terk., Kjušu Imp. Univ. 7, 1937, 255-273, 6 text-figs.).

The results of the author's observation extending over more than ten years concerning the plant succession in a certain land section reclaimed from the sea near the Hukuoka City, Kyûsyû are mentioned in this paper.

The plants which appear in this land section are either halo- or mesophytic. Of the former *Suaeda* appears on the mud at first and is followed by *Atriplex* and *Statice*. The latter are soon invaded by many herbs and grasses, as *Artemisa*, *Oenothera*, *Erigeron*, *Chaetochloa*, *Imperata*, etc., all of which come simultaneously. All formations above mentioned are however covered up finally by *Phragmites*.



**296. Die Bedeutung der Symbiose zwischen einigen endophytischen Blaualgen und ihren Wirtspflanzen.** (M. japan. Zfg.). Tuneo TAKESIGE. (Bot. Mag. Tôkyô **51**, 1937, 514-524 m. 1 Taf., 622-623).

Vor Jahren hat MOLISCH seine Experimentalresultate veröffentlicht, wonach gewisse *Blasia*- und *Cavicularia*-arten ohne von der symbiotischen *Nostocart* begleitet zu werden, nicht leben können, und weiter als diese letztere Art den freien Stickstoff zu assimilieren fähig ist, sie durch Hingabe dieser Assimilate das Leben der obengenannten Lebermoosen ermöglicht. Dank einer Reihe von Kulturexperimenten hat der Verf. die der MOLISCHschen Angaben nicht übereinstimmenden Resultate bekommen. Vor allem hat der Verf. die aus den Dauerbrutkörpern entwickelten ganz *Nostoc*-freie *Blasia*-Individuen bekommen und sie auf Nähragar oder Nährflusssand mit Erfolg kultivieren können. Auf Grund des Verfs. ziemlich umfangreichen Versuchen ist es ganz klar, dass die *Blasia*-wohnende *Nostocart* nicht einheitlich ist, und er konnte davon verschiedene Arten entweder mikroskopisch oder physiologisch unterscheiden, ja sogar konnte er an *Blasia* die aus der Cycadeenwurzel isolierten *Nostocart* gedeihen lassen.

Weiter, obgleich MOLISCH die Assimilation des freien Stickstoffes durch die in Rede stehenden *Nostocart* nachgewiesen zu haben behauptete, konnte der Verf. diese Tatsache keineswegs bestätigen, ausgenommen bei einer aus *Cavicularia* isolierten *Nostocart*, wobei zumindest das Stattfinden dieses Vorganges wahrscheinlich ist.

Schliesslich behauptet der Verf. die Notwendigkeit des Zusammenlebens gewisser Bodenbakterien für das einwandfreie Gedeihen von den Reinkulturen des oben zitierten Lebermooses.

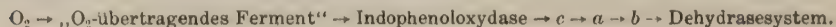
**297. Über den Wirkungsmechanismus der einzelnen Cytochromkomponenten in der Zellatmung.** Hiroshi TAMIYA und Yasuyuki OGURA. (Acta Phytochim., **2**, 1937, 123-158).

Die Verfasser gingen von der Feststellung aus, dass bei Spektroskopierung der Hefesuspension unter kinetisch-stationären Bedingungen, d.h. unter ständiger Durchströmung der Gasmischung von bestimmtem  $O_2$ -Gehalt, die oxydierten und die reduzierten Formen der einzelnen Cytochromkomponenten dann in folgendem Mengenverhältnis vertreten, wenn die Aktivität des Dehydrasesystems sowie die Menge des dargereichten Sauerstoffs genügend gross ist:

$$\left( \frac{\text{reduzierte } b\text{-Komponente}}{\text{oxydierte } b\text{-Komponente}} \right) > \left( \frac{\text{reduzierte } a\text{-Komponente}}{\text{oxydierte } a\text{-Komponente}} \right) > \left( \frac{\text{reduzierte } c\text{-Komponente}}{\text{oxydierte } c\text{-Komponente}} \right).$$

Durch Vergleich der Oxydations- und der Reduktionsgeschwindigkeit einzelner Cytochromkomponenten unter nicht-kinetisch-stationären Bedingungen kamen die Verfasser zu dem Schluss, dass die oben erwähnte Tatsache einen Beweis dafür darstellt, dass in dem Mechanismus der Zellatmung die drei Cytochromkomponenten nicht unabhängig von einander durch  $O_2$ -direkt oder indirekt-oxydiert und durch Dehydrasesystem reduziert werden können. Unter den Bedingungen, in denen die kinetisch-stationäre Oxydoreduktion nicht in Erscheinung tritt, wurde die titrationsmässige Oxydation und Reduktion der Cytochromkomponenten ausgeführt, wodurch gezeigt werden konnte, dass unter den drei Cytochromkomponenten *c* das höchste und *b* das niedrigste Normalredoxpotential besitzt.

Gestützt auf diese Ergebnisse haben die Verfasser folgendes Schema für den Mechanismus der Hefeatmung vorgeschlagen:





Der Unterschied zwischen diesem und dem von O. WARBURG vorgeschlagenen Atmungsschema wurde näher besprochen. Ferner wurde gezeigt, dass die oxydoreduktive Funktion von  $a$  durch mehrere chemisch indifferente oberflächenaktive Substanzen gehindert wird, sodass dadurch bei dauernder Lüftung  $c$  in oxydiertem und  $b$  in reduziertem Zustand stabilisiert wird. Schliesslich haben die Verfasser versucht, die Abhängigkeit der Cytochromtypen der Mikroorganismen von dem  $O_2$ -Bedarf durch ihre neue Theorie zu erklären.

TAMIYA.

**298. Bemerkungen über die oxydoreduktiven Verhältnisse der Cytochromkomponenten, und über die Verschiedenheit der Cytochromtypen der Zellen.** Hiroshi TAMIYA und Tadao SATO. (Bot. Mag., Tôkyô, **51**, 1937, 254-262).

Die oben referierte Theorie von TAMIYA und OGURA wurde hier zum Teil ergänzt und zum Teil weiter entwickelt. Unter der Annahme, dass im Zellinnern unter kinetisch-stationärer Bedingung stets mehr oder weniger ausgeprägtes Gefälle des Redoxpotentials zwischen „ $O_2$ -Ort“ und „Dehydrase-Ort“ ausgebildet werden soll, haben die Verfasser dargelegt, dass je nach der Grösse der Potentialdifferenz zwischen dem Oxydations- und dem Reduktions-Ort des Cytochrommediums verschiedene relative Mengenverhältnisse der oxydierten und reduzierten Formen der einzelnen Cytochromkomponenten beobachtet werden können. Bezeichnet man mit

$\gamma$ : das Verhältnis  $\frac{\text{Konzentration der reduzierten } c\text{-Komponente}}{\text{Konzentration der oxydierten } c\text{-Komponente}}$

$\beta$ : das Verhältnis  $\frac{\text{Konzentration der reduzierten } b\text{-Komponente}}{\text{Konzentration der oxydierten } b\text{-Komponente}}$

$\left(\frac{\gamma}{\beta}\right)_e$ : das Verhältnis von  $\gamma$  zu  $\beta$  bei echtem thermodynamischem Gleichgewicht

und ferner mit

$v$ : die Geschwindigkeit der Atmung,

$K$ : die Geschwindigkeitskonstante bei der indirekten Reaktion des oxydierten  $c$  mit dem reduzierten  $b$ ,

$k_o$ : die Geschwindigkeitskonstante bei der indirekten Reaktion des reduzierten  $c$  mit dem Sauerstoff,

$k_r$ : die Geschwindigkeitskonstante bei der Reaktion des oxydierten  $b$  mit dem Dehydrasesystem,

$[O_2]$ : die Konzentration des dargereichten Sauerstoffs,

$[R]$ : die Stärke des Dehydrasesystems,

so ist durch kinetische Betrachtung der kettenmässigen Oxydoreduktion der Cytochromkomponenten folgendes zu schliessen:

$$\text{bei } v < \frac{k_o k_r}{K} [O_2] [R] \quad \text{ist} \quad \frac{\gamma}{\beta} < 1,$$

$$\text{bei } v = \frac{k_o k_r}{K} [O_2] [R] \quad \text{ist} \quad \frac{\gamma}{\beta} = 1,$$

$$\text{bei } \left(\frac{\gamma}{\beta}\right)_e \frac{k_o k_r}{K} [O_2] [R] > v > \frac{k_o k_r}{K} [O_2] [R] \quad \text{ist} \quad \left(\frac{\gamma}{\beta}\right)_e > \frac{\gamma}{\beta} > 1,$$

$$\text{bei } v = \left(\frac{\gamma}{\beta}\right)_e \frac{k_o k_r}{K} [O_2] [R] \quad \text{ist} \quad \frac{\gamma}{\beta} = \left(\frac{\gamma}{\beta}\right)_e.$$

Damit konnten die Bedingungen für das Zustandekommen verschiedener relativer Mengenverhältnisse der oxydierten und reduzierten Formen von  $c$  und  $b$ -Komponente

aufgeklärt werden. Schliesslich haben die Verfasser darauf hingewiesen, dass mit der Annahme des stationären Potentialgefälles im Zellinnern auch die Mannigfaltigkeit der Cytochromtypen in Abhängigkeit von dem Grad des O<sub>2</sub>-Bedarfs der Organismen begreiflich gemacht werden kann.

TAMIYA.

**299. The application of ringing and wiring to interspecific crosses of the genus *Gossypium*.** Masao TANAKA. (Mem. Coll. Agric., Kyôto Imp. Univ. No. 39, 1937, 1-7).

In the crossing between *Gossypium herbaceum* and *G. hirsutum* the author has either bound tightly with wire or ringed the flowering branch at the internode adjacent to the pollinated flower. This procedure has led to the considerable increase of the percentage of successes of crossing, as compared with the control, thus, for instance, at least 56.41% against 35.5% in the control crossing. This interesting result may be due to the hinderance of the flowing away of assimilation products from the growing part of the operated branch towards other parts.

**300. Über die Verwertbarkeit der Aminosäuren, Polypeptide und Diketopiperazine für Pilzwachstum.** Yasuo TAZAWA und Syunzi YAMAGATA. (Acta Phytochim., 9, 1937, 299-310).

Die Verwertbarkeit von Aminosäuren, Polypeptiden und Diketopiperazinen als N-Quelle für das Wachstum von *Aspergillus niger* und *oryzae* ist unter besonderer Berücksichtigung der enzymatischen Aufspaltbarkeit der Peptidringe vergleichend untersucht. Während alle Aminosäuren und Polypeptide immer sehr gut verwertet werden, verhalten sich die Diketopiperazine je nach ihrer Struktur und der Versuchsbedingung mehr verschiedenlich. Z.B. bei pH 3.4 zeigen sich die sauren und basischen Diketopiperazine (Glycyl-d-Glutaminsäureanhydrid, Aspartan und Diaminopropionsäureanhydrid) als gute N-Quelle, während die neutralen Diketopiperazine dazu untauglich sind, woraus ist es ersichtlich, dass die Diketopiperazine zu meist nur dann zur N-Ernährung der Schimmelpilze dienen, wenn sie vorher durch Pilzenzyme (Acido- bzw. Baso-Cyclopeptidase von K. SHIBATA) der hydrolytischen Ringspaltung unterliegen können. Aber unter Umständen können auch einige neutrale Diketopiperazine, wahrscheinlich durch die oxydative Desaminierung, spärlich verwertet werden.

**301. Studies on the physiological specialization in *Ophiobolus Miyabeanus* ITO et KURIBAYASHI.** Yoshihiko TOCHINAI and Masayuki SAKAMOTO. (Jour. Fac. Agric., Hokkaido Imp. Univ. 41, 1937, 1-96, 3 pls. and 2 text-fig.-groups).

*Ophiobolus Miyabeanus* is well known in Japan as causing a serious disease of rice plants. The authors have collected the rice plants attacked by this fungus from various parts of Japan, and by isolating it they have cultured its 32 strains, each starting from a single spore. Four kinds of nutrient media were employed for the culture, viz. rice or potato decoction agar, SAITO's soy agar and RICHARD's nutrient agar. The growth type of the fungus is variable according to the difference of the nutrient media as well as that of strains, so that the authors could distinguish on the whole 10 different growth types. The temperature relation of various strains was studied on the fungus cultured in SAITO's soy agar, and it was found that the best growth takes place between 25-30°C.

During the author's culture the saltations, either sector- or patch-type, were frequently met with. Some saltants remained constant through 10 successive generations, while other reverted soon to the original form.

On rice decoction agar medium a morphological variation of conidia was observed among the sporulating strains, but no such was observed in the potato decoction agar medium.

The inoculation experiments of the authors have proven that the pathogenicity is more or less variable in ten strains of the fungus, which points out towards the occurrence of specialization of the fungus in this respect. Furthermore, the resistance power of various races of rice plant against the invasion of this fungus was found to be various.

**302. Einfluss der Mikroelemente auf das Wachstum des Gemüses. I. *Raphanus sativus* L. var. *macropodus* MAKINO f. *roseus* MAKINO.** (Japanisch m. deutsch. Zfig.). MATUO TOKUOKA und HITOSI MOROOKA. (Jour. Soc. Trop. Agric. **9**, 1937, 12-25).

Zu der Nährlösung (pH = 6) der Wasserkulturen der im obigen Titel genannten Gemüsepflanze wurde Bor (als Borsäure), Kupfer, Mangan und Zink in verschiedener Menge hinzugefügt. Die Resultate davon waren wie folgt. Das Bor hemmt das Wachstum der Pflanze, sogar in sehr kleiner Menge, das Kupfer wirkt giftig, sogar mehr als das Bor, das Mangan wirkt ebenso giftig, obgleich es in 0,01-0,1 p.p.m. einen grossen Mehrertrag veranlasst hat, ebenso war es der Fall bei Zink in 0,1 p.p.m.

**303. *Spicilegium muscologiae Asiae Orientalis* 2-3.** (With Japanese résumé). REIZO TOYAMA. (Acta Phytotax. et Geobot. **6**, 1937, 42-25, 101-107, 7 text-figs. in all).

The following new species are announced: *Neckera viridis*, *Gymnostomiella rhyukyuensis*, *Hookeriopsis yakusimensis*, *Barbula sublaevifolia*, *B. ochrocarpa*, *Pylaisia montana*.

**304. Some experiments on the germination and growth of *Calystegia Soldanella* R. BR. and *Lathyrus japonicus* WILL.** (Japanese with English résumé). MICHIO TSUDA. (Bot. Mag. Tôkyô **51**, 1937, 379-387, 4 text-figs.).

*Calystegia Soldanella* and *Lathyrus japonicus* are very common in seashore of Japan. The germination of their seeds was studied either on filter-paper or cotton, and the growth of seedlings on sand. Such substrata were moistened with the solution of BRENNER's artificial sea-water in various concentrations, for example, sea- and tap-water, each 50% (=1/2), 25% sea-water and 75% tap-water (=1/4), etc. Light has no influence at all on the germination. This process takes place equally well without any salt at all or with the addition of its small quantity, and when its addition becomes larger, the germination rate falls down markedly. The maximum growth was seen in the absence of salt or 1/32 artificial sea-water, and it decreases parallel to the increase of the amount of salt to stop entirely, when the 3/4 or 1/4 sea-water is employed.

**305. *Plantae boninenses novae vel criticae* VIII-IX.** TAKESI TUYAMA. (Bot. Mag. Tôkyô **51**, 1937, 22-24, 125-132, altogether 8 text-figs., 33).

Concerning *Pandanus boninensis* WARB. the author could distinguish *planata* f. nov., *flavo-stricta* f. nov., *stenocarpa* var. nov., *disticha* comb. nov. All are illustrated.

Further, the following new species are described and illustrated among others: *Aristida boninensis*, *Panicum pacificum*, *Rubus Nakaii*.

**306. On *Platypholis boninsimae* MAXIMOWICZ and its systematic position.** (With Japanese résumé). TAKESI TUYAMA. (Bot. Mag. Tôkyô **51**, 1937, 279-285 with 1 pl. and 3 text-figs., 403).

*Platypholis boninsimae* is an orobanchaceous plant of the Bonin Islands first described in 1886. The name was given by MAXIMOWICZ, and his description was founded

on dried specimens of the young plant. The author could get recently living as well as alcohol specimens of fully developed stock of this plant, and he describes it fully in this paper basing on such specimens. BECK stated that the plant is tricarpetate, but the author's present observation has shown that such is a rare exception and that it is bicarpetate as the rule. He thinks that the genus *Platypholis* is allied to *Orobanche*, especially to the section *Osproleon*.

**307. A report on the meiosis in the two hybrids, *Brassica alba* RABENH. ♀ × *R. oleracea* L. ♂ and *Eruca sativa* LAM. ♀ × *B. oleracea* L. ♂.** Nagaharu U, Tutumi NAGAMATU and Usaburô MIDUSIMA. (Cytologia, FUJII Jub. Vol. 1937, 437-441, 3 text-figs.)

Two hybrids which are mentioned in the above title are quite sterile, and no  $F_2$  plants were obtainable, so that the authors could study simply the cytological features of the  $F_1$  plants.

*B. alba* differs so considerably from other species of the same genus, that it was formerly included among the genus *Sinapis*. Nuclei of the root-tip cells of the  $F_1$  hybrids show 21 somatic chromosomes which correspond to the sum of  $n$  chromosome numbers of the two parents ( $9 + 12$ ). The pollen mother-cells behaved quite irregularly, thus not a single syndetic union was observed; 21 univalents were scattered in the first metaphase spindle, and a typical semi-heterotypic division occurred. A few restitution nuclei were found, and the lagging of chromosomes was frequent.

The second division is rather regular. Pollen grains are mostly small and shrivelled.

In the  $F_1$  hybrid *Eruca sativa* ♀ × *Brassica oleracea* ♂ the number of chromosomes at diakinesis of PMC ranges from 17 to 20, and evidently some of them are bivalent. The bivalence may be due to the autosyndetic union of the chromosomes among either of the two parents or to the allosyndetic union of those of the two parents, though the author could not determine which of these two alternatives is realized in the present case.

**308. Über die Atmung und die Assimilation bei einigen Wassermoosen.** Shojichiro USAMI. (Acta Phytochim., 9, 1937, 287-297, 1 Textabb., auch in Bot. Mag. Tôkyô, 51, 1937, 372-379, 2 Textabb. in japanisch m. deutsch. Zfg.).

Die Atmungsintensität  $Q_{O_2}$  (ohne Zusatz des Atmungssubstrats) von drei Arten der Wassermoose, *Fontinalis antipyretica*, *Chiloscyphus fragilis* und *Riccia fluitans* beträgt etwa 0,6-3,0. Bei Zugabe der für die Atmung der grünen Pflanzen oft in Betracht kommenden Atmungssubstrate findet nur eine geringfügige Atmungssteigerung statt; z.B. einige Kohlenhydrate (Glucose, Galactose, Saccharose) und Fettsäuren (Essigsäure, Buttersäure) rufen die Steigerung der Atmung nur um 10,5% bis 18,5% hervor. Die Wirkung des Substratzusatzes kann durch vorheriges Aushungern der Pflanze nicht verstärkt werden. Kaliumcyanid (M/50-M/10000) wirkt gewissermaßen hemmend auf die Moosatmung, sowohl bei Zugabe wie bei Nichtzugabe von Glucose. Methylenblau übt keinen Einfluss auf die Atmung aus, dagegen wirkt das Äthylurethan deutlich hemmend. Die Assimilation ( $O_2$ -Abgabe) der Moose wird durch M/1000 Hydroxylamin vollständig sistiert und diese Hydroxylaminwirkung wird von Prof. K. SHIBATA auf die Vergiftung der Katalase zurückgeführt, die die Hauptrolle in der BLACKMANSchen Reaktion spielt. Aber das Hydroxylamin ist in eine Konzentration von M/500-M/1000 ganz einflusslos auf die Moosatmung. Kaliumcyanid wirkt in gleicher Konzentration schwächer hemmend als Hydroxylamin auf die Assimilation. Die Bestimmung der Gaswechselgrösse erfolgte manometrisch nach O. WARBURG.

Verf.



**309. Untersuchungen über die Substrate für Sauerstoffatmung von Süsswasser- und Meeresalgen. Beiträge zur Stoffwechselphysiologie der Algen. II.** Atsushi WATANABE. (Acta Phytochim., 9, 1937, 235-254).

Bei mehreren Süsswasser- und Meeresalgen untersuchte der Verf. die Steigerung der Atmungsgrösse durch Zusatz verschiedener organischer Substanzen. Dabei wird die Atmung von *Chlorella ellipsoidea* durch Zusatz von Aldehyden, mehrwertigen Alkoholen, Kohlehydraten, Aminosäuren und gewissen Carbonsäuren erhöht, wobei die aliphatischen Fettsäuren die grösste Wirksamkeit zeigen. Bei den grünen, braunen und roten Meeresalgen bewirken im allgemeinen Aldehyde, ein- und mehrwertige Alkohole und Kohlehydrate keine nennenswerte Atmungssteigerung, ausgenommen Mannit bei Braunalgen. Bei Chlorophyceen und Phaeophyceen wird die Atmung durch Zusatz von Aminosäuren und Fettsäuren deutlich gesteigert, wobei vielfach die Molekülgrösse der letzteren für die Wirkung massgebend ist. Der grösste Wirkungsgrad wird sowohl bei *Chlorella* wie auch bei grünen und braunen Meeresalgen durch Fettsäuren mit 8 bis 10 Kohlenstoffatomen erreicht. Iso-Säuren bewirken stets viel geringere Atmungssteigerung als die entsprechenden normalen Säuren. Einige ungesättigte Fettsäuren, Oxy- und Ketomonocarbonsäuren steigern auch ziemlich deutlich die Atmungsgrösse von grünen und braunen Meeresalgen, während Dicarbonsäuren und Tricarbonsäuren dabei nur in geringem Grade wirksam sind. Die Atmung von Rhodophyceen wird nur durch Zugabe von Aminosäuren in gewissem Grade gesteigert, am deutlichsten bei *Gracilaria confervoides*. Die Fragen bezüglich der Katalysatorsysteme für die Zellatmung von verschiedenen Algen wurden im Zusammenhang mit der chemischen Natur der brauchbaren Substrate kurz diskutiert, wobei darauf hingewiesen wurde, dass die Sauerstoffaufnahme mit Hilfe des cyanunempfindlichen Flavoproteinsystems und die durch das cyanempfindliche Indophenolase-Cytochromsystem nebeneinander in den Zellen der Algen verwirklicht werden kann.

Verf.

**310. Über die Verbreitung des Flavins in Meeresalgen. Beiträge zur Stoffwechselphysiologie der Algen. III.** Atsushi WATANABE. (Acta Phytochim., 9, 1937, 255-264).

Die Versuche über den Flavingehalt der Meeresalgen wurden durchgeführt. In meerbewohnenden Rot-, Braun- und Grünalgen kommt das Flavin weit verbreitet vor; der durchschnittliche Flavingehalt der 57 vom Verf. untersuchten Algen ist 0.18% pro g Frischgewicht. Unter allen untersuchten Meeresalgen zeigten die Rotalgen, *Iridaea pulchra* und *I. laminarioides*, den grössten Flavingehalt (1.10% bzw. 1.07% pro g Frischgewicht). Die Braunalge *Heterochordaria abietina* wies den nächstgrossen Flavingehalt auf: 0.65% pro g Frischgewicht. Der Flavingehalt von Braun- und Grünalgen ist im allgemeinen kleiner als der von Rotalgen. In Rot- und Braunalgen liegen 57-96% des gesamten Flavins in gebundener Form (als Flavoprotein) vor, und daher scheint es, dass Flavin in den lebenden Zellen der Meeresalgen im Sinne des WARBURGSchen „gelben Oxydationsferments“ im Zellstoffwechsel fungiert. Das Flavin ist in den getrockneten Handelswaren von Meeresalgen, besonders in „Asakusanori“ (*Porphyra tenera*), in gutem Zustand erhalten, was als eine ergiebige Quelle des Vitamins B<sub>2</sub> betrachtet werden kann.

Verf.

**311. Über die Beziehung zwischen der Protoplasmaströmung und den elektrischen Potentialveränderungen bei Myxomyceten.** (Japanisch m. deutsch. Zfg.). Atsushi WATANABE, Masahiko KODATI und Saburo KINOSHITA. (Bot. Mag. Tôkyô, 51, 1937, 337-349, 4 Textfig.)



Die Verf. untersuchten die Frage, ob und wie die Richtung der Protoplasmaströmung in Pflanzenzellen mit deren elektrischen Potentialveränderungen im Zusammenhang stehen. Als Versuchsmaterial dienten die Plasmodien von Myxomyceten. Mit Hilfe eines Mikromanipulators führten die Verf. zwei unpolarisierbare Mikroelektroden in das Plasmodium von *Didymium nigripes* Fr. var. *xanthopus* LISTER ein, und die elektrischen Potentialdifferenzen wurden an zwei beliebigen Stellen des Plasmodiums mit einem hochempfindlichen Vakuumröhre-Potentiometer gemessen. Bei den an einem Hauptstrang des Plasmodiums in 1.5 mm Abstand aufgelegten Mikroelektroden bemerkt man, dass die Kurve der elektrischen Potentialveränderungen wesentlich mit der Kurve des Richtungswechsels der Plasmaströmung in Übereinstimmung steht, wobei aber die Wellen der ersteren Kurve denjenigen der letzteren mehr oder weniger vorangehen. Wenn die eine Elektrode an den Frontteil eines Plasmodiums und die andere an das äusserste Ende einer seiner Hauptadern gelegt und die Potentialdifferenz zwischen beiden Elektroden gemessen wird, so zeigt der Frontteil des bewegenden Plasmodiums in allen Fällen die höheren (positiveren) Potentialwerte als der hintere geäderte Teil, woraus man leicht erkennt, dass das Protoplasma die Neigung hat, von einer Stelle mit niedrigerem Potential nach einer Stelle mit höherem Potential stärker zu strömen. Für diese enge Beziehung zwischen der Plasmaströmung und der elektrischen Potentialdifferenz spricht auch das Resultat des folgenden Versuchs, nämlich beeinflussen die von Aussen aufgelegten elektrischen Potentiale deutlich die Strömungsperiode des Plasmodiums: wenn die Anode an den Frontteil des Plasmodiums gelegt wird, so verlängert sich die Plasmaströmungsdauer nach der Front und wenn dagegen die Kathode aufgelegt wird, so verkürzt sich diese Dauer. Werden die Elektroden eines Akkumulators an den Agarboden in gewisser Entfernung von kriechendem Plasmodium angelegt, so empfindet das Plasmodium den elektrischen Reiz und zeigt eine deutliche negative Galvanotaxis, d.h. die Lokomotion des Plasmodiums nach der Kathode. Bei diesem Versuch wurde die Potentialdifferenz zwischen dem Front- und Hinterteile des Plasmodiums gemessen, und es wurde gefunden, dass der Potentialwert des Frontteils ansteigt. Also erklärten die Verf. die negative Galvanotaxis des Plasmodiums aus der Potentialsteigerung des Frontteils und der damit zusammenhängenden Verstärkung der frontwärts gerichteten Plasmaströmung. Diese Potentialsteigerung des Frontteils wird auch durch Einwirkung von hineindiffundierenden Wasserstoffionen hervorgerufen, so dass die positive Chemotaxis des Plasmodiums gegen Säuren auch auf die gleiche Ursache zurückgeführt werden kann. Die bedingenden Faktoren für periodische Potentialschwankungen im Plasmodium, etwa die oxydo-reduktiven Stoffwechselvorgänge, werden aber für eine spätere Untersuchung vorbehalten.

Verf.

**312. Untersuchungen über die Polyphenolasen.** Eijiro YAKUSHIJI. (Acta Phytochim. 10, 1937, 63-80).

Der Verfasser untersuchte die Spezifitäten und andere Eigenschaften der Polyphenolase aus *Lactarius piperatus* und Catecholoxydase aus Kartoffeln und aus einem Hymenogastracee-Pilze, *Octaviania columelifera*. Die Polyphenolase aus *Lactarius* (Pilzlaccase) wurde durch Acetonfällung und fraktionierte Ammonsulfatfällung dargestellt. Die Spezifität ihrer Wirkung wurde mit Hilfe von etwa sechzig Phenolderivaten studiert. Diese Polyphenolase zeigt einen weiten Wirkungsbereich in bezug auf die Substituenten und die Stellungen der Phenolhydroxyle bzw. der Aminogruppe in Substratmolekülen. Für die Angreifbarkeit durch diese Phenolase muss wenigstens eine Hydroxyl- bzw. Aminogruppe in Substratmolekülen frei bleiben. Im Gegen-

satz zu Tyrosinase oxydiert dieses Enzym unter Monoxybenzolderivaten nur diejenigen, welche Seitenkette an Ortho-Stellung führen. Die optimale Wasserstoffionenkonzentration ist verschieden je nach dem Substrat. Das stark wirksame Präparat zeigt bei Reduktion mit Hydrosulfit eine Hämochromogen-Bande bei 550–560  $m\mu$ , und somit stellt ihre Wirkgruppe sehr wahrscheinlich ein Protohämatin dar. Eine Catecholoxydase aus *Octaviana* ist in bezug auf ihre Spezifität, ganz wie bei der Catecholoxydase aus Kartoffeln, auf die orthohydroxylierten Polyphenole beschränkt. Cyanid wirkt auf die Wirkung der Pilzlaccase sowie der Pilz-Catecholoxydase hemmend ein, und zwar viel stärker auf die der letzteren. Kohlenoxyd hemmt nur die Wirkung der Catecholoxydase, nicht aber der Pilzlaccase, und diese Hemmung ist nicht durch Belichtung aufhebbar. Aminosäuren beschleunigen die Wirkung der beiden Polyphenolasen, indem sie sich mit den bei Phenoloxydation entstehenden Chinonen zu Farbstoffen verbinden und dadurch das Potential der Reaktionssysteme niedriger halten. Verf.

**313. Über die Absorptionsbanden des Oxycytochroms c.** Eijiro YAKUSHIJI. (Acta Phytochim. **10**, 1937, 125–128).

Das Cytochrom c wurde aus Rinderherzmuskel mit Schwefelsäure extrahiert und durch Füllen mit Ammoniumsulfat und Kochsalz und schliesslich durch Elektrodialyse gereinigt (Fe: 0.286%). Das Absorptionsspektrum wurde mit Hilfe des ZEISSschen Mikrospektroskops beobachtet. Dieses Cytochrom zeigt in saurer Lösung (HCl, Oxalsäure) vier Banden mit dem Absorptionsmaximum bei etwa 625  $m\mu$ , 565  $m\mu$ , 538  $m\mu$  und bei 498  $m\mu$ . In Bernsteinsäure-,  $KH_2PO_4$ - bzw. NaOH-Lösung wurde nur zwei Banden bei 575  $m\mu$  (565  $m\mu$ ) und 540  $m\mu$  beobachtet. Aus diesem Versuche und durch Vergleich mit anderen Parahämatinbanden (Methämoglobin, Oxycytochrom b aus Hefe und Katalase aus Leber) hat Verfasser den Schluss gezogen, dass zwei Banden bei 625  $m\mu$  und 498  $m\mu$  saure Hämatinbanden und zwei Banden bei 575  $m\mu$  und 540  $m\mu$  Alkali-Hämatinbanden sein müssen, und dass das Absorptionsspektrum des Oxy-Cytochroms c nichts anderes als ein Hämatinspektrum darstellt, das infolge äusserst basischer Eigenschaft des Cytochroms c komplizierter aussieht. Die Lage der sogenannten Hauptabsorption wurde durch photographische Aufnahme mittelst des Quarzspektrographen ADAM HILGERS, mit Eisenbogen als Lichtquelle, untersucht und in Übereinstimmung mit der Angabe von H. THEORELL (407  $m\mu$ ) gefunden. Verf.

**314. Über die Hemmung der Katalase-Wirkung durch Polyphenole und aromatische Polyamine.** Eijiro YAKUSHIJI. (Bot. Mag. Tōkyō. **51**, 1937, 299–302).

Die katalatische Wirksamkeit wurde durch Titration mit  $n/100$   $KMnO_4$ -Lösung bei 0°C bestimmt. Der wirksamste Hemmungsstoff gegen Katalasewirkung ist Pyrogallol, das schon bei  $1.1 \times 10^{-5}$  Mol. Konzentration eine 50-proz. Hemmung aufweist. Darauf folgt Pyrogallol-o-carbonsäure, Gallussäure, Brenzcatechin, Hydrochinon, *p*-Phenylendiamin u.a. Die von Pyridinhämin oder Pilzlaccase nur schwer angreifbare *meta*-Verbindungen wirken weniger hemmend. Dass die Hemmung nicht nur durch Polyphenole, sondern auch durch aromatische Polyamine hervorgerufen wird, weist darauf hin, dass die Hemmung nicht einfach durch Unterbrechung der Kettenreaktion, im Sinne von F. HABER und R. WILLSTÄTTER, sondern durch die Fixierungsaффinität hervorgerufen wird. Verf.

**315. Untersuchungen über das Cytochrom b. Isolierung, Eigenschaften und seine Rolle im Reaktionsmechanismus der Zellatmung.** Eijiro YAKUSHIJI u. Takeshi MORI. (Acta Phytochim. **10**, 1937, 113–123).

Die Reduktion der drei Cytochromkomponenten in der Co-Dehydrasefrei ausgewaschenen Trockenhefe durch das Alkoholdehydrasesystem kann stets nur durch Zugabe von Co-Dehydrase hervorgebracht werden.

Die durch Hydrosulfitreduktion hergestellte Dihydro-Co-Dehydrase kann nicht das Oxycytochrom c reduzieren. Diese Reduktion kann jedoch durch Pyridinhämin vermittelt werden. Das Cytochrom b wurde aus Bäckerhefe isoliert und als Trockenpräparat erhalten. Diese Hämatinsubstanz ist ebenso wie das Pyridinhämin an der betreffenden Reaktion wirksam. Die oxydierte Form des Cytochroms b zeigt drei Banden: 640 m $\mu$ , 572 m $\mu$ , 540 m $\mu$ ; mit Hydrosulfit lässt es sich in die reduzierte Form umwandeln: 564 m $\mu$ , 532 m $\mu$ ; darauf mit Pyridin versetzt: ein typisches Pyridinprotohämochromogenspektrum. Der Fe-Gehalt des Präparates betrug 0.2%.

Cytochrom b verzögert die Methylenblau-reduktion beim Alkoholdehydrase-Co-Dehydrasesystem und zwar um so deutlicher, je mehr Flavoprotein vorhanden ist und somit zeigt Cytochrom b eine stärkere Affinität zu genanntem System als Flavoprotein.

Das oxydierte Cytochrom b kann sowohl durch das Alkoholdehydrase-Co-Dehydrasesystem als auch durch die Lactatdehydrase mit Lactat deutlich reduziert werden.

Das reduzierte Cytochrom b stellt ein autoxydables Hämochromogen dar und reagiert mit Oxycytochrom c sehr glatt.

Aus den Versuchsergebnissen wird das folgende Schema für den Mechanismus der Häminsistem-Atmung höchst wahrscheinlich gemacht:

O<sub>2</sub>.....Cytochrom c—Cytochrom b—Co-Dehydrase—Dehydrase—Substrat.

T. MORI.

**316. Über die Alkoholdehydrase aus der Rübe.** Syunzi YAMAGATA und Masasi NAGAHISA. (Acta Phytochim., **9**, 1937, 115–122).

Durch Alkohol-Äther-Fällung des Rübenpresssaftes lässt sich eine Alkoholdehydrase als ein zellfreies Trockenpräparat isolieren. Neben verschiedenen primären Alkoholen greift diese Dehydrase auch Glutaminat an, während verschiedene aliphatische Säuren (Formiat, Lactat, Succinat, Malat, Citrat, Asparaginat, Glykokoll u.a.) als Substrat vollständig unbrauchbar sind. Acetaldehyd wird auch nicht verwertet. Die optimale Konzentration des Äthylalkohols: 1 M–1/2 M. pH-Optimum: 7.0–8.0. Ferner ist die Notwendigkeit der Co-Dehydrase (Co-Zymase) sowie auch des Flavin-enzym für die Wirkung dieser Dehydrase sicher nachgewiesen. Verff.

**317. Über die Oxydation von verschiedenen Phenolkörpern und Phenylendiaminen durch *Bacillus pyocyaneus*. Beiträge zur Atmungsphysiologie der Bakterien. III.** Seizaburo YAMAGUTCHI. (Acta Phytochim., **10**, 1937, 171–198).

In dieser Arbeit wurden die Wirkungen des phenylendiamine- bzw. phenolkörperoxydierenden Enzyms von *Bacillus pyocyaneus* systematisch untersucht.

Beim Vergleich der Umsatzgrösse von 15 Substanzen findet man mit der intakten Bakteriensuspension folgende Reihenfolge:

*p*-Phenylendiamin > Tyrosin > Hydrochinon > Brenzcatechin, *p*-Aminophenol, *o*-Aminophenol > Resorcin, Pyrogallol  $\geq$  *o*-Phenylendiamin, *m*-Phenylendiamin, *m*-Aminophenol, Phloroglucin, *p*-Kresol, *o*-Kresol und *m*-Kresol.

Dabei werden die zuletzt genannten 7 Substanzen gar nicht angegriffen. Durch Vorwärmung der Suspension (90 Min. lang auf 52°) wird die O<sub>2</sub>-Aufnahme gar nicht beeinflusst oder sogar gewissermassen beschleunigt bei

*p*-Phenylendiamin, Hydrochinon und *p*-Aminophenol,

und mehr als 70% herabgesetzt bei anderen Substraten. Andererseits hemmt M/1000 KCN die O<sub>2</sub>-Absorption bei Zugabe von

*p*-Phenylendiamin, Hydrochinon, *p*-Aminophenol und Tyrosin

um mehr als 70% und die von anderen Substraten nur in unbedeutendem Masse oder gar nicht. Mit Rücksicht auf alle obigen Umstände kann man wohl schliessen, dass 3 *p*-Verbindungen, d.h. *p*-Phenylendiamin, Hydrochinon und *p*-Aminophenol, durch CN-empfindliche „Oxydase“ oder „Oxydasen“ oxydatisch, dagegen Tyrosin durch gewöhnliches Zellatmungssystem dehydratisch oxydiert wird, während die Mehraufnahme des Sauerstoffes, die bei Zugabe einiger anderer Substanzen oft beobachtet wird, durch einen anderweitigen wärmeempfindlichen und CN-refraktären Nebenmechanismus herbeigeführt wird.

Ferner wird die Oxydation der 3 genannten *p*-Verbindungen sowie die von reduziertem Cytochrom *c* mit zellfreiem Phosphateextrakt von *Bacillus pyocyaneus* bestätigt. Wie bei Hefe- bzw. Muskelenzym, werden hierbei auch die CN-Empfindlichkeit und CO-Unempfindlichkeit der Oxydasewirkung einwandfrei nachgewiesen. Verf.

**318. Einige Untersuchungen über das Cytochrom der Bakterien.** Seizaburo YAMAGUCHI. (Bot. Mag. Tôkyô **51**, 1937, 457-461, 1 Textabb.)

Die Lage und Absorptionsstärke der einzelnen Cytochromstreifen wurden bei 20 Bakterienarten vergleichend untersucht. Dabei bemerkt man:

- 1) 'b- (oder b<sub>1</sub>-) Streifen ist bei allen Bakterienarten stets vorhanden.
- 2) Wenn der a-Streifen fehlt oder wenigstens nicht sichtbar ist, sind stets die Streifen a<sub>2</sub> und a<sub>1</sub> oder der Streifen a' vorhanden.
- 3) Der c-Streifen ist bei fast allen untersuchten Bakterienarten vorhanden. Bei *Proteus*-Arten und *Bacillus coli communis*, die bisher als c-frei bekannt sind, wird dieser Streifen ziemlich deutlich nachgewiesen.
- 4) Die Streifen a<sub>2</sub> und a<sub>1</sub> kommen nur bei *B. coli communis* und *Proteus*-Arten zur Beobachtung. Der Streifen a<sub>2</sub> ist stets viel intensiver und schärfer als a<sub>1</sub>.

Ferner wurden mit Phosphatsuspension der Bakterien das Verschwinden bzw. Auftreten der einzelnen Cytochromstreifen sowie die Einwirkung des Cyankaliums auf dieselben untersucht und folgende Tatbestände bestätigt:

- 1) Durch heftige Schüttelung mit Luft werden alle a<sub>2</sub>-, a<sub>1</sub>-, a-, a'-, b-, b<sub>1</sub>- und c-Streifen sofort vollständig zum Verschwinden gebracht.
- 2) Beim ruhigem Stehen treten alle Streifen wieder an ursprünglichen Lagen auf.
- 3) Bei Zugabe der verdünnten Blausäure werden das Verschwinden des Streifens teilweise oder vollständig verhindert. Verf.

**319. Pulvinus als der Hauptsitz der in den Primärblättern entstehenden Potentialänderungen bei *Canavalia ensiformis* DC.** (M. japon. Zfg.). Yasuke YAMAGUTI. (Bot. Mag. Tôkyô **51**, 1937, 430-436, 2 Textabb., 615).

Vor Jahren hat der Verf. die den Schlafbewegungen parallel verlaufenden periodischen elektrischen Potentialänderungen in den Primärblättern von *Canavalia ensiformis* erwähnt (vgl. diese Jour. **6**, (59), Nr. 202). Indem damals die Potentialänderung bloss an der Oberfläche der Organe nachgewiesen worden ist, ist die Tatsache, ob solches Phänomen auch im Innern derselben geschieht, weiter zu erforschen,



was im vorliegenden Aufsatz geschildert worden ist. Nach den Resultaten der Verfs. Beobachtungen, wobei die Platiniridiumdrähte als Elektroden in den Gewebe eingesteckt wurden, ist es vor allem festgestellt, dass das elektrische Potential im Gewebe des Pulvinus und in der Mittelrippe gegen dasselbe des Stengels bei der Nacht immer negativ und beim Tage positiv oder ihre Negativität stark erniedrigt ist. Im Pulvinus erster Ordnung (=P. am Grunde der Blattspreite und dem oberen Ende des Blattstieles) und im demselben zweiter Ordnung (=P. zwischen dem Stengel und dem Blattstiel) bei beiden, Ober- und Unterseite, ist das elektrische Potential gegen das des Blattstieles und der Mittelrippe stark negativ, und auch ist die Breite der Potentialänderung bedeutend grösser. Während bei dem Pulvinus erster Ordnung das Potential der Unterseite gegen dasselbe der Oberseite stark negativ ist, ist es gerade umgekehrt bei demselben zweiter Ordnung, was stimmt mit der wohlbekannten Tatsache überein, dass bei der Schlafbewegung der Pulvinus erster Ordnung an seiner Unterseite und derselbe zweiter Ordnung an seiner Oberseite gedrückt wird. Alle oben angedeutete Phänomene müssen zeigen, dass der Hauptsitz der periodischen elektrischen Potentialänderungen, welche den Schlafbewegungen der Primärblätter parallel verlaufen, in dem Pulvinusgewebe zu suchen ist.

### 320. Kataphoretische Versuche an den Pollenmutterzellen einiger Pflanzen.

Gihei YAMAHA. (Cytologia, FUJII Jub. Bd., 1937, 617-626, 1 Taf. und 3 Textabb.).

Die sich teilenden Pollenmutterzellen von *Tradescantia reflexa*, *Lilium Maximowiczii*, *Lilium auratum* und *Lilium speciosum* wurden aus den Antheren in verschiedene Salzlösungen von bestimmter Ionenkonzentration (KCl, Kaliumphosphat, Kaliumazetat) herausgepresst, durch die ein elektrischer Strom bestimmter Stärke (0,5-10 Milliampère) mit Hilfe der KCl-Agar-Elektroden hindurchgeleitet wurde. Die völlig reversibel verlaufende Wirkung der Elektrizität auf verschiedene Strukturelemente der Pollenmutterzellen wurde unter Mikroskop beobachtet.

Die sämtlichen Strukturelemente des Protoplasmas (Plasmalemma, Mikrosomen, Karyotingranula, Chromosomen, Spindelsubstanz, Nukleolen usw.), falls Elektrophorese überhaupt eintritt, verschieben sich immer nach der Anode, was ohne weiteres auf die negative Ladung derselben schliessen lässt. Diese Elektronegativität des Protoplasmas wird durch die diffuse Vitalfärbung mit sauren Farbstoffen nicht im geringsten vermindert, sondern im Gegenteil merklich vergrössert. Das Zytoplasma erfährt eine bedeutende Aufquellung, welche eine Volumvergrösserung der ganzen Zelle nach sich zieht. Der Zellkern schrumpft hingegen bedeutend. Dabei tritt die Kernmembran, die in normalem Zustand kaum sichtbar ist, deutlich hervor. Wir haben somit hier mit der reversiblen Koagulation des Karyoplasmas durch die Elektrizität zu tun.

Die Messung der Rückgangsgeschwindigkeit der Kataphorese hat sich als eine Schätzungsmethode der Protoplasmaviskosität bzw. -elastizität brauchbar erwiesen. Die kataphoretische Geschwindigkeit, wie auch die Rückgangsgeschwindigkeit verschiedener Strukturelemente in der Pollenmutterzelle schwankt im Laufe der Karyokinese in weitem Masse. Die Beobachtungsflüssigkeit hat darauf einen nicht unbedeutenden Einfluss.

Verf.

### 321. Zur Methodik und Theorie der Vitalfärbung pflanzlicher Protoplasten.

(M. japan. Zfg.). Gihei YAMAHA. (Bot. Mag. Tōkyō 51, 1937, 533-538, 625-626).

Bei der Vitalfärbung pflanzlicher Protoplasten hat man bisher die Methode der Milieufärbung benutzt, wobei man einzelne Zellen, Gewebe- oder Organstücke in

verdünnte wässrige Farbstofflösung taucht. Als dabei die Farbstofflösung als das Aussemmium wirkt, muss man diejenigen Eigenschaften derselben berücksichtigen, welche als Aussemmium der Zellen unentbehrlich erscheinen, um die behandelten Materialien im gesunden Zustande erhalten zu können. Davon sind besonders zwei Punkte wichtig, nämlich osmotische Eigenschaft und das pH-Verhältnis. Indem bei der Vitalfärbung eine sehr verdünnte Farbstofflösungen im Gebrauch ist, ist sie hypotonisch und wirkt quellend. Die Hypotonie wirkt schädigend auf das Protoplasma, wodurch die Permeabilität desselben erhöht und die Färbung begünstigt wird. Es ist wohl bekannt, dass die Hypertonie der Lösung, welche entquellend wirkt, zum gleichartigen schädigenden Resultat führt. Es ist praktisch schwer, eine dem Protoplasma ganz isotonische Farbstofflösung zu beschaffen, welche somit auf demselben weder quellend noch entquellend wirkt. In dieser Beziehung empfiehlt der Verf. für die Vitalfärbung das Paraffinöl als Lösungsmittel der Farbstoffe, worin eine grosse Anzahl derselben lösbar sind.

**322. Observationes ad floram formosanam XVI.** Yoshimatsu YAMAMOTO. (Jour. Soc. Trop. Agric. **9**, 1937, 84-98, 1 text-fig.)

Continuation of the author's study of Formosan plants in the American and European herbaria. This article contains the following genera: *Lagenophora*, *Lagdera*, *Myriactis*, *Picris*, *Ligularia*, *Siegesbeckia*, *Senecio*, *Solidago*, *Sonchus*, *Sphaeranthus*, *Synedrella*, *Vernonia* and *Wedelia*.

**323. Beitrag zum Intersexualitätsproblem bei *Aucuba japonica*** THUNB. Yukio YAMAMOTO. (Cytologia, FUJII Jub. Bd. 1937, 181-187, 9 Textabb.).

Betreffend das Zahlenverhältnis der Geschlechter bei dem wildwachsenden Stock von *Aucuba japonica* ist es merkwürdig, dass die männlichen Pflanzen viel zahlreicher vertreten sind als die weiblichen, im Gegensatz zu den bisher im allgemeinen beobachteten Fällen der diözischen Pflanzen.

In den Intersexen von *Aucuba japonica* gibt es allerlei Uebergänge zwischen beinahe rein männlichen und rein weiblichen Blüten.

Die haploide Chromosomengarnitur normaler *Aucuba japonica* beträgt 16, welche nach MEURMAN aus acht, je viermal vertretenen verschiedenen Chromosomentypen besteht. Die somatische Garnitur der männlichen Intersexen enthält ausser derselben zwei überzählige Fragmente, welche Weibchengenē enthalten und somit zu der Störung der Geschlechtsverhältnisse führen könnten.

Obleich der Pollen der intersexuellen männlichen Pflanze äusserlich ganz gesund ist, konnte die mit demselben bestäubte weibliche Pflanze bloss 14% aufgesetzt haben. Es muss bemerkt werden, dass auf weiblicher Seite diese Pflanze vollkommen steril war.

**324. Die Chromosomenzahl von wildwachsenden Teepflanzen in Formosa.** (Japanisch). Kosuke YAMASHITA. (Agric. & Hort. **12**, 1937, 1583-1584, 2 Textfig.).

Als die vom Verf. untersuchten in Formosa wildwachsenden Teepflanzen durch eine bedeutend grosse Statur ausgezeichnet sind, hat er die Chromosomenzahl ihrer Wurzelspitzenzellen ausgerechnet, um zu sehen, ob irgend eine Variation derselben aus den gewöhnlichen Teepflanzen nachzuweisen ist. Diese Erwartung des Verfs. wurde nicht erfüllt, da die Chromosomenzahl ( $2n = 30$ ) gleich wie bei den gewöhnlichen Teepflanzen beträgt.

**325. Genetische Untersuchungen über den Markgehalt der Weizenhalme.** Kosuke YAMASHITA. (Mem. Coll. Agric., Kyōto Imp. Univ. No. **39**, 1937, 9-36, 7 Textabb.).

form the basal body or blepharoplast of the cilium. The conjugation of two planocytes occurs in two ways: each begins to fuse by one of its ends (telo-conjugation) or laterally (para-conjugation); in either case the blepharoplast of each planocyte is absorbed by its own nucleus.

Sometimes the planocyte enters into a cysto-stage, and from the latter two new planocytes are developed through a mitotic division. In such case the centrosome concerned in this division becomes directly the blepharoplast of the new cysto-stage, the blepharoplast being absorbed by its nucleus.

# Weitere Untersuchungen über die pentaploiden *Triticum*-Bastarde VIII

## Die Entwicklung der verschiedenchromosomigen Endospermen in den Rückkreuzungen des Bastards *T. polonicum* × *T. spelta* zu den Eltern<sup>(1)</sup>

Von Seiji MATSUMURA

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Hierzu 5 Textabbildungen u. 5 Tabellen

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(Eingegangen am 15. April 1938)

### Einleitung

Bei Bestäubungen, die zwischen verschiedenchromosomigen Weizenarten vorgenommen wurden, erhielt man viel mehr Körner, wenn die Art mit mehr Chromosomen als Pollenträger benutzt wurde, als umgekehrt. Hingegen war die Keimung im ersteren Falle schlechter als die der Körner, die sich durch reziproke Kreuzung ergaben. Ueber diese Verhältnisse bei den pentaploiden Bastarden zwischen den Emmer- und Dinkelreihen sind Mitteilungen von WATKINS (1927, 1932), THOMPSON und CAMERON (1928), THOMPSON (1930 a und b), WAKAKUWA (1930, 1934), MATSUMURA (1936 a und b) und BOYES und THOMPSON (1937) erschienen.

Auf Grund von eingehenden embryologischen Untersuchungen haben WAKAKUWA (1934) sowie BOYES und THOMPSON (1937) die Beziehung zwischen der Körnerentwicklung und der Genomkonstitution bei den Bastarden des Weizens bestätigt. Die Körner in der Verbindung Dinkel (AABBDD) ♀ × Emmer (AABB) ♂ waren alle plump, während die Samen aus reziproker Kreuzung runzelig waren. In den reziproken Kreuzungen haben die Embryonen gleichfalls 35 Chromosomen und die Genomformel 2(AB) + D. Dagegen besitzen die Endospermen je nach der Kreuzungs-

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(1) Contributions from the Laboratory of Genetics, Biological Institute, Department of Agriculture, Kyoto Imperial University, No. 95.



richtung verschiedene Chromosomenzahlen und Genomkonstitutionen. Die Genomformel des 56-chromosomigen Endospermkerns in der Kreuzung mit Dinkel als Mutter ist nämlich  $3(AB) + 2D$ , während in der reziproken Kreuzung ein Endospermkern 49 Chromosomen und die Formel  $3(AB) + D$  hat. Die Verschiedenheit der Entwicklung des Endosperms in den reziproken Verbindungen scheint auf dem Unterschied der Genomkonstitution im Endosperm zu beruhen.

Bei den Rückkreuzungen der pentaploiden Bastarde (*T. durum*, *T. dicoccum* oder *T. persicum*  $\times$  *T. vulgare*) zu den Eltern hat THOMPSON (1930 a) die Verhältnisse zwischen der Entwicklung und den Chromosomenzahlen des Endosperms untersucht. Die Endospermen sind plump und gross, wenn sie (a) kein Chromosom oder wenige Chromosomen des D-Genoms und (b) 3 vollkommene oder fast vollständige D-Genome enthalten. Plumpe und kleine Körner werden gewöhnlich bei Samen erhalten, deren Endospermen 2 vollständige oder fast vollkommene D-Sätze haben. Die Endospermen sind runzelig oder eingeschrumpft, wenn sie (a) haploid für den ganzen Satz oder mehrere Dinkelchromosomen und (b) diploid oder triploid für nur wenige Elemente sind.

Ueber einen derartigen an einem umfangreichen Material in den Rückkreuzungen des Bastards *T. polonicum*  $\times$  *T. spelta* zu den Eltern ausgeführten Versuch wird in der vorliegenden Mitteilung berichtet.

Diese Untersuchung wurde auf Anregung und unter Leitung von Herrn Professor Dr. H. KIHARA ausgeführt, dem ich auch an dieser Stelle meinen herzlichsten Dank aussprechen möchte. Ferner konnte ich zum Teil unveröffentlichte Ergebnisse von Herrn SH. WAKAKUWA benutzen, wofür ich zu Dank verpflichtet bin.

## Material und Methoden

Der für die gegenwärtige Untersuchung benutzte Bastard war derselbe, der das Material für die vorigen Untersuchungen dieser Serie (IV-VII) geliefert hat, nämlich *Triticum polonicum* L. var. *vestitum* KÖRN.  $\times$  *T. spelta* L. var. *Duhamelianum* KÖRN.. Die beiden Rückkreuzungen wurden stets reziprok ausgeführt, wobei die somatischen Chromosomenzahlen in den Wurzelspitzen bei den Aequationskreuzungen  $F_1 \times$  Eltern von KIHARA und WAKAKUWA (IV. Mitt.) und bei den Zertationskreuzungen Eltern  $\times F_1$  von MATSUMURA (VI. Mitt.) bestimmt wurden.

Für die Herstellung der Abbildungen wurden die Samenkörner in natürlicher Grösse, wie sie vor dem Säen photographiert worden waren, entsprechend der Chromosomenzahl der Keimlinge in einer Reihe angeordnet.

## Beziehung zwischen der Gestalt der Körner und der Zahl der Chromosomen

Abbildung 1 zeigt die Samenkörner der Eltern und der  $F_1$ -Bastarde. Die Samen beider Eltern waren dickkörnig und besaßen eine gute Keimfähigkeit (mehr als 90%). *T. polonicum* ergab etwas weniger dicke Körner und zeigte schwächere Keim- sowie Lebensfähigkeit der Keimlinge als *T. spelta*. Beim  $F_1$ -Bastard mit *T. polonicum* als Mutter war der Körneransatz besser als in der reziproken Kreuzung. Die Körner im letzteren Falle waren nicht nur alle elliptisch plump und kleiner als die im letzteren, sondern wiesen auch bessere Keimfähigkeit auf; die Keimlinge aus diesen Körnern waren in höherem Masse lebensfähig. Die Kreuzung mit *T. spelta* als Pollenträger ergab mit schlanke und runzelige oder eingeschrumpfte Körner mit geringerer Keimfähigkeit, die Keimlinge mit geringerer Lebensfähigkeit entwickelten (vgl. Tab. 4 der VI. Mitt.).



Abb. 1. Körner der Eltern und der  $F_1$ -Bastarde.

- a. *T. polonicum*, b. *T. spelta*,  
c. *T. polonicum*  $\times$  *T. spelta*,  
d. *T. spelta*  $\times$  *T. polonicum*.

**Aequationsversuch.** Die Körner aus der Verbindung  $F_1 \text{ } \varnothing \times T. \text{ polonicum } \text{ } \sigma$  waren im allgemeinen plump, wie aus Abbildung 2 zu ersehen ist. Die Keimung dieser Körner war, wie zu erwarten, etwas besser und die Lebensfähigkeit der Keimlinge merklich stärker als in der Kreuzung  $F_1 \times T. \text{ spelta}$  (vgl. Tab. 3 der IV. Mitt.). Bei den gekeimten Körnern mit 28- bis 35-chromosomigen Embryonen, deren Chromosomenzahlen aus den Wurzelspitzen der Keimlinge bestimmt wurden, schien im allgemeinen die Körnergrösse mit der Vermehrung der Anzahl der Chromosomen abzunehmen. Die höherchromosomigen Körner (z.B. die mit 34 sowie 35 Chromosomen) waren kleiner, ähnlich wie die  $F_1$ -Samen in der Kreuzung *T. spelta*  $\varnothing \times T. \text{ polonicum } \sigma$ .

Zwei unerwartet erhaltene Körner mit 38 bzw. 48 Chromosomen waren ebenfalls plump und auch etwas kleiner. Demnach könnten diese Körner durch die Verschmelzung höherchromosomiger Eizellen mit minderchromosomigen Spermakernen entstanden sein. Unter 3 ungekeimten Körnern wurde ein ziemlich runzeliges Korn gefunden.



Abb. 2. Körner in  $F_1 \times T. polonicum$ .

a. ungekeimte Körner, b und c. Körner mit unerwarteten Chromosomenzahlen; b.  $2n = 48$ , c.  $2n = 38$ .

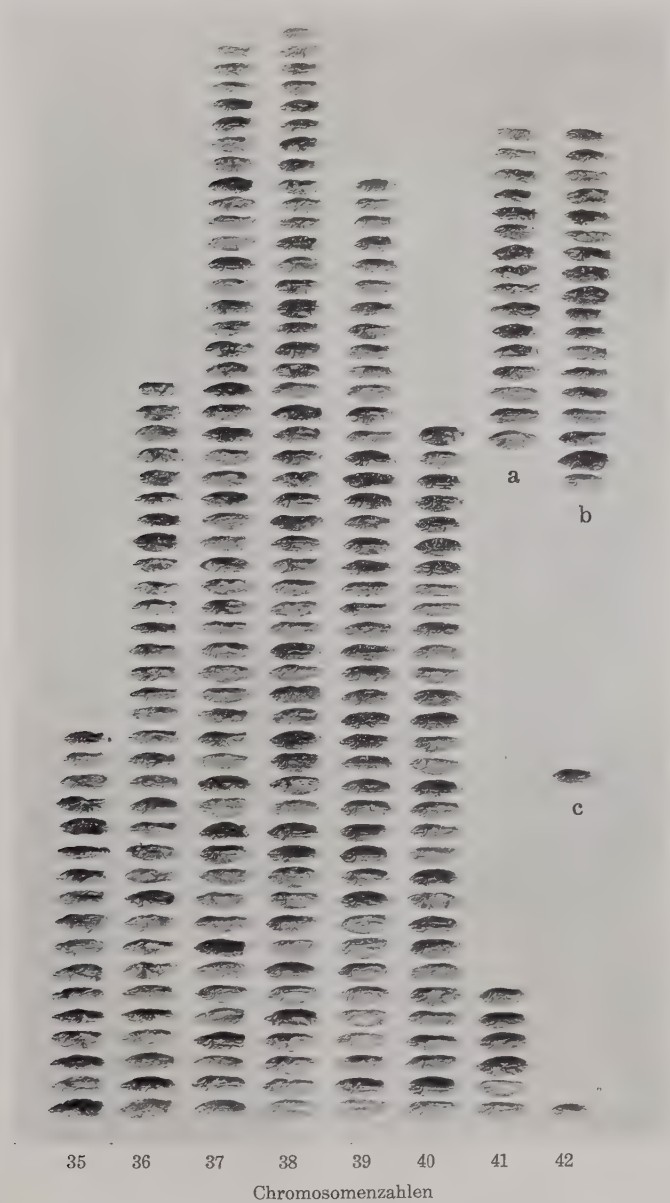


Abb. 3. Körner in  $F_1 \times T. spelta$ .

a. ungekeimte Körner, b. von Keimlingen eingegangene Körner, c. Korn mit unerwarteter Chromosomenzahl;  $2n = 32$ .



Abbildung 3 zeigt die Körner in der Rückkreuzung des  $F_1$ -Bastards mit *T. spelta* als Pollen. Diese Körner waren im allgemeinen länger als die bei  $F_1 \times T. polonicum$ , ausserdem sehr viel runzeliger oder eingeschrumpfter. Alle ungekeimten Körner und fast alle nach der Keimung eingegangenen Körner<sup>(1)</sup> zeigten sich runzelig oder eingeschrumpft. Bei den 35-chromosomigen Pflanzen waren die ursprünglichen Körner ebenfalls alle runzelig oder eingeschrumpft, ähnlich wie bei den  $F_1$ -Bastarden  $T. polonicum \text{ } \varnothing \times T. spelta \text{ } \sigma$ . Bei den 36-chromosomigen Pflanzen waren ebenfalls fast alle Körner runzelig oder eingeschrumpft. Der Grad der Schrumpfung eines Kornes und die Zahl der runzeligen oder eingeschrumpften Körner nehmen Hand in Hand mit der Vermehrung der Chromosomenzahl ab. Die 41-chromosomigen Körner waren ziemlich plump und ein 42-chromosomiges Korn wies die gleiche Plumpheit auf, wie das von *T. spelta*. Die Körnergrösse schien in dieser Kreuzung, im Gegensatz zu der früheren Kreuzung, von der Chromosomenzahl unabhängig zu sein.

Das Korn, das sich unerwartet als eine Pflanze mit 32 Chromosomen entwickelte, war ziemlich plump und etwas kleiner.

**Zertationsversuch.** Für beide Zertationskreuzungen, Eltern  $\times F_1$ , wurden I. Versuche in den Jahren 1934/35 und II. in den Jahren 1935/36 ausgeführt. Beide Versuche ergaben gleiche Resultate in bezug auf die Endospermenverhältnisse. In der Kreuzung  $T. spelta \times F_1$  waren im allgemeinen fast alle Körner plump, ebenso wie die in der Aequationskreuzung  $F_1 \times T. polonicum$ . In ersterem Falle besaßen die Körner eine merklich stärkeres Keimungsvermögen und die Lebensfähigkeit der Keimlinge war besser als in der Kreuzung  $T. polonicum \times F_1$  (vgl. Tab. 5 u. 6 der VI. Mitt.). Abbildung 4 zeigt 96 Körner im II. Rückkreuzungsversuch in den Jahren 1935/36 mit *T. spelta* als Mutter, von denen 7 nicht gekeimt hatten. Unter diesen ungekeimten war nur ein Korn ziemlich runzelig. Die Körner mit 35-chromosomigen Embryonen zeigten eine ähnliche Gestalt wie die der Kreuzung  $T. spelta \text{ } \varnothing \times T. polonicum \text{ } \sigma$ . Die Grösse der verschiedenenchromosomigen Körner schien zum grössten Teil der Anzahl der Chromosomen zu entsprechen. Die oben erwähnte Kreuzung  $F_1 \times T. polonicum$ , in der die Körnergrösse mit der Erhöhung der Chromosomenzahl abnimmt, zeigte ein entgegengesetztes Verhalten.

Ein Korn mit unerwartetem 44-chromosomigen Embryo im II. Versuch war dickkörnig, wie Abbildung 4 zeigt. Ein anderes 44-chromosomiges Korn im I. Versuch war ebenfalls plump und gross (vgl. MATSUMURA, 1937).

Bei der Verbindung  $T. polonicum \times F_1$  wurden viel runzelige oder eingeschrumpfte Körner beobachtet, wie bei der Verbindung  $F_1 \times T.$

(1) Diese Körner haben im November 1933 gekeimt und sind vor der Fixierung der Wurzelspitzen im Dezember 1933 eingegangen.

*spelta*. Die Körner in der ersteren Kreuzung des II. Versuchs aus den Jahren 1935/36 sind in Abbildung 5 zu sehen. Zahlreiche ungekeimte Körner waren fast alle runzelig oder eingeschrumpft. In dieser Verbindung waren die minderchromosomigen Körner (z.B. die mit 28 sowie 29 Chromosomen) alle plump, während die höherchromosomigen (z.B. die

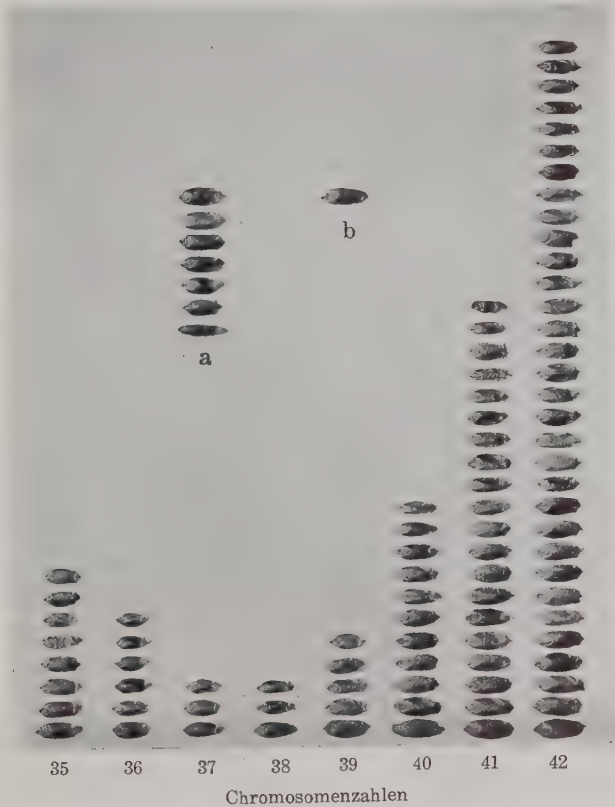


Abb. 4. Körner in *T. spelta* ×  $F_1$ .

a. ungekeimte Körner, b. Korn mit unerwarteter Chromosomenzahl;  $2n = 44$ .

mit 34 sowie 35 Chromosomen) runzelig oder eingeschrumpft waren, ähnlich wie die bei der Kreuzung *T. polonicum* ♀ × *T. spelta* ♂. Demnach geht die zahlenmässige Vermehrung der runzeligen oder eingeschrumpften Körner und die Zunahme des Runzeligkeitsgrades eines Korns Hand in Hand mit der Erhöhung der Chromosomenzahl. D. h. das Verhalten in der Kreuzung *T. polonicum* ×  $F_1$  ist entgegengesetzt dem in der Ver-

bindung  $F_1 \times T. spelta$ , wobei nämlich die Runzeligkeit mit der Verminderung der Anzahl der Chromosomen zunimmt.

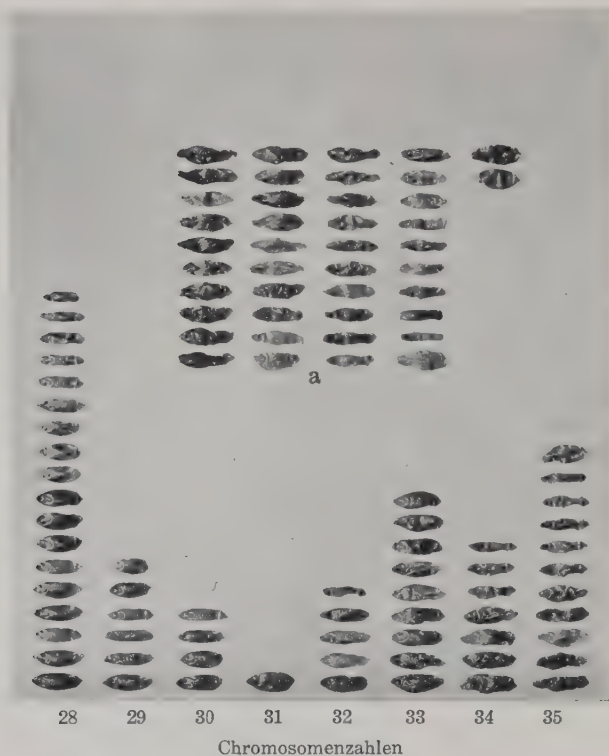


Abb. 5. Körner in  $T. polonicum \times F_1$ .

a. ungekeimte Körner.

Von zwei unerwarteten 36-chromosomigen Pflanzen im I. Versuch in den Jahren 1934/35 bei der Kreuzung  $T. polonicum \times F_1$  war das ursprüngliche Korn der einen mit der Chromosomenformel  $15_{II} + 6_I$  in der Reifeteilung etwas runzeliger—ebenso wie bei der Kreuzung  $T. polonicum \varphi \times T. spelta \sigma$ —als die der anderen mit der Formel  $14_{II} + 8_I$  oder  $1_{III} + 13_{II} + 7_I$  (vgl. MATSUMURA, 1937).

### Beziehung zwischen Keimung und Chromosomenzahl

Die Beziehung zwischen der Chromosomenzahl und der Anzahl der Tage bis zur Keimung wurde nur bei Zertationskreuzungen untersucht.

Beim I. Versuch dieser Kreuzungen wurden 211 Körner in der Verbindung *T. spelta* × F<sub>1</sub> bzw. 203 in der von *T. polonicum* × F<sub>1</sub> im Gewächshaus in Kisten mit steriler Erde mittags am 27. Oktober 1934 ausgesät. Sie ergaben 210 Keimlinge in der ersteren Verbindung und 158 in der letzteren (vgl. Tab. 5 der VI. Mitt.). Tabelle 1, die als Korrelationstabelle eingerichtet ist, bringt die Beziehung zwischen der Chromo-

TABELLE 1. Korrelation zwischen Chromosomenzahl und Keimung der Körner in Versuch I

Chromosomenzahl		Tage bis zur Keimung									Summe
		3	4	5	6	7	8	9	10	11	
<i>T. polonicum</i> × F <sub>1</sub>	28	2	12	6	3						23
	29		6	3	1						10
	30		3								3
	31	1	1								2
	32		7	1							8
	33	2	11	5		1					19
	34	1	9	9	9			1	1		30
	35	1	17	17	16			1			52
	36*			1	1						2
	**		1	1	2		1	3		1	9
	Summe	7	67	43	32	1	1	5	1	1	158
<i>T. spelta</i> × F <sub>1</sub>	35	6	15	4							25
	36	2	11	4							17
	37		5								5
	38	1	5	1							7
	39	2	9								11
	40	1	12								13
	41	18	32	3							53
	42	25	46	7							78
	44*	1									1
	Summe	56	135	19							210

\* Unerwartet.

\*\* Im Keimlingsstadium eingegangen.

somenzahl und der Anzahl der Tage bis zur Keimung bei diesen Keimlingen zur Darstellung. Die im Keimlingsstadium eingegangenen Pflanzen stammten meist aus den später gekeimten Körnern der Verbindung *T. polonicum* × F<sub>1</sub>.

Beim II. Versuch am 15. November 1935 wurden 96 Körner der Verbindung *T. spelta* × F<sub>1</sub> bzw. am 14. November 104 von *T. polonicum* × F<sub>1</sub>



im Zimmer in viereckigen Pflanzentöpfen mit sterilem Sand um Mittag zur Keimung gebracht. Aus ihnen wurden 89 Keimlinge in der ersteren bzw. 62 in der letzteren erzielt (vgl. Tab. 6 der VI. Mitt.). Auf dieselbe Weise wurden am 15. November die Körner von beiden Eltern und den

TABELLE 2. Korrelation zwischen Chromosomenzahl und Keimung der Körner in Versuch II

Chromosomenzahl		Tage bis zur Keimung							Summe
		3	4	5	6	7	8	9	
<i>T. polonicum</i>	28	4	3	2					9
<i>T. polonicum</i> × <i>F</i> <sub>1</sub>	28		14	4					18
	29		4	2					6
	30		2	2					4
	31			1					1
	32		1	2	2				5
	33		6	2	1				9
	34		4	3					7
	35		1	7	2			1	11
	**		1						1
Summe			33	23	5	0	0	1	62
<i>T. polonicum</i> × <i>T. spelta</i> rez.	35	4	6	3					13
	35	2	11	5		1			19
<i>T. spelta</i> × <i>F</i> <sub>1</sub>	35	3	4	1					8
	36	2	3	1					6
	37	2		1					3
	38	1		2					3
	39	1	3		1				5
	40	5	6						11
	41	7	10	2		1			20
	42	18	8	4		1	1		32
	44*		1						1
Summe		39	35	11	1	2	1		89
<i>T. spelta</i>	42	7	1	1					9

\* Unerwartet.

\*\* Im Keimlingsstadium eingegangen.

reziproken *F*<sub>1</sub>-Bastarden ausgesät. Die sich beim II. Versuch ergebenden Verhältnisse sind aus Tabelle 2 zu ersehen, die ebenfalls als Korrelations-tabelle eingerichtet ist.

TABELLE 3. Korrelation zwischen Chromosomenzahl und Keimung der Körner

Chromosomenzahl		Tage bis zur Keimung								Summe
		3	4	5	6	7	8	9	10	
<i>T. polonicum</i> $\times F_1$	28	2	26	10	3					41
	29		10	5	1					16
	30		5	2						7
	31	1	1	1						3
	32		8	3	2					13
	33	2	17	7	1	1				28
	34	1	13	12	9			1	1	37
	35	1	18	24	18			2		63
	Summe	7	98	64	34	1	0	3	1	208
<i>T. spelta</i> $\times F_1$	35	9	19	5						33
	36	4	14	5						23
	37	2	5	1						8
	38	2	5	3						10
	39	3	12		1					16
	40	6	18							24
	41	25	42	5		1				73
	42	43	54	11		1	1			110
	Summe	94	169	30	1	2	1			297

Die Resultate sind in beiden Versuchen nahezu gleich. Aus ihrer Zusammenfassung ergibt sich die folgende Tabelle (Tab. 3), mit Ausnahme der Keimlinge mit unerwarteten Chromosomenzahlen und der Pflanzen, die im Keimlingsstadium vor Bestimmung der Chromosomenzahl eingegangen sind. Im grossen und ganzen keimten die Körner von *T. spelta*  $\times F_1$  früher als die von *T. polonicum*  $\times F_1$ . In der letzteren Verbindung ist zwischen der Chromosomenzahl und der Zeitdauer bis zur Keimung deutlich eine positive Korrelation zu beobachten, deren Koeffizient  $r = +0.2952 \pm 0.0433$  ist, während die Verbindung *T. spelta*  $\times F_1$  mit Korrelationskoeffizienten  $r = -0.0999 \pm 0.0387$  keine Beziehung erkennen lässt. Wie oben erwähnt, sind die Körner bei *T. spelta*  $\times F_1$  fast alle plump, ihre Grösse nimmt im allgemeinen entsprechend dem Anstieg der Chromosomenzahl zu. Demnach scheint der Zeitpunkt der Keimung, d.h., ob die Körner früher oder später keimen, nicht von ihrer Grösse abhängig zu sein. Bei *T. polonicum*  $\times F_1$  verhält sich auch die Runzeligkeit der Körner parallel der Anzahl der Chromosomen. Je runzeliger die Körner sind, desto später scheint daher die Keimung einzutreten. Die ganz runzeligen Körner vermochten schliesslich nicht zu keimen.

## Diskussion

Wenn das 42-chromosomige Elter als Pollenträger benutzt wurde, war, wie oben in der Einleitung erwähnt, der Körneransatz viel besser als in der reziproken Kreuzung. Mit der Keimfähigkeit verhielt es sich aber umgekehrt. Deshalb wurden viel mehr  $F_1$ -Pflanzen erzielt, wenn der Vater 28-chromosomig war, als in der Gegenkreuzung<sup>(1)</sup>. Die Ergebnisse der gegenwärtigen Untersuchung stimmen mit denen der bisherigen Studien überein. Die Gestalt der Körner bei den  $F_1$ -Bastarden war ebenfalls je nach der Kreuzungsrichtung verschieden (Abb. 1). Die Körner waren in der Kreuzung Emmer ♀ × Dinkel ♂ alle schlank und runzelig oder eingeschrumpft, ihre Endospermen zeigten die Genomformel 3(AB) + D. Dagegen wurden in der reziproken Kreuzung kleinere und plumpe Samen mit der Formel 3(AB) + 2D in den Endospermen erzielt, d.h. die Körner mit den nur einen D-Satz enthaltenden Endospermen waren runzelig oder eingeschrumpft, während diejenigen, die für das D-Genom der Endospermen diploid sind, dickkörnig waren.

Diese Verhältnisse wurden durch die reziproken Rückkreuzungen bestätigt. In der Verbindung  $F_1 \times T. polonicum$  waren fast alle Körner, welche gewöhnlich die bessere Keimfähigkeit aufwiesen, plump. In den Gonen der 35-chromosomigen  $F_1$ -Pflanzen waren die Chromosomenzahlen von 14 bis 21 zu erwarten. Diese Rückkreuzung des Bastards mit *T. polonicum* als Pollen ergab 28- bis 35-chromosomige Zygoten. Demnach können wir im grossen und ganzen, mit Ausnahme der 28-chromosomigen Zygoten, diese Kreuzung als eine solche: höherchromosomig ♀ × minderchromosomig ♂ betrachten, ähnlich wie Dinkel ♀ × Emmer ♂. In der Verbindung *T. spelta* ×  $F_1$  waren auch die Samen mit stärkerem Keimungsvermögen fast alle plump. In diesem Falle haben die Embryonen 35 bis 42 Chromosomen, weil die 21-chromosomigen weiblichen Gameten sich mit 14- bis 21-chromosomigen männlichen verbinden. Es dürfte diese Rückkreuzung im allgemeinen ebenfalls, abgesehen von den 42-chromosomigen Zygoten, als eine Verbindung höherchromosomig ♀ × minderchromosomig ♂ angesehen werden.

Hingegen wurden bei den Kreuzungen  $F_1 \times T. spelta$  und *T. polonicum* ×  $F_1$  zahlreiche runzelige oder eingeschrumpfte Körner beobachtet, deren Keimung mangelhaft war und aus denen sich Keimlinge mit schwacher Lebensfähigkeit entwickelten. Die 35- bis 42-chromosomigen Zygoten in der ersteren Kreuzung  $F_1 \times T. spelta$  müssen auf einer Ver-

(1) SAX (1921) beobachtete, dass die Körner in der Kreuzung mit einer Emmerart als Mutter ein wenig schwerer waren, als in der reziproken. Einen Unterschied zu den reziproken Kreuzungen in bezug auf die Runzeligkeit der Körner stellte er nicht fest.

bindung weiblicher Gameten mit 14 bis 21 Chromosomen und 21-chromosomigen männlichen beruhen. Auf dieselbe Weise ergibt die Kreuzung *T. polonicum*  $\times$   $F_1$  die 28- bis 35-chromosomigen Zygoten durch die Verschmelzung der 14-chromosomigen weiblichen Gameten mit 14- bis 21-chromosomigen männlichen. Mit Ausnahme der 42-chromosomigen Zygoten in  $F_1 \times T. spelta$  und der 28-chromosomigen in *T. polonicum*  $\times$   $F_1$  können wir im allgemeinen beide Rückkreuzungen als Bastarde von minderchromosomigen Eizellen und höherchromosomigen Pollen betrachten, ähnlich wie Emmer  $\varphi \times$  Dinkel  $\sigma$ .

Bei diesen vier Rückkreuzungen vermochten wir auf Grund der Anzahl der somatischen Chromosomen in den Wurzelspitzen die Anzahl der Dinkelchromosomen und die Genomkonstitution der Embryonen sowie der Endospermen zu erkennen. In der Kreuzung *T. polonicum*  $\times$   $F_1$  und der reziproken weist z.B. die 33-chromosomige Pflanze die gleiche Chromosomenformel  $2(AB) + 5d$  im Embryo auf, aber eine verschiedene Konstitution im Endosperm. In dieser Formel wollen wir einfachheitshalber ein Chromosom des Dinkelgenoms mit dem Buchstaben *d* bezeichnen, dann besitzt ein D-Genom 7 verschiedene *d*-Chromosomen. Im Endosperm muss die 33-chromosomige Pflanze in der Verbindung *T. polonicum*  $\times$   $F_1$  die Formel  $3(AB) + 5d$  haben, während die Konstitution der gleichchromosomigen Pflanze in der reziproken  $3(AB) + 2(5d)$  ist. Die Endospermformel muss ebenfalls z.B. beim 39-chromosomigen Keimling der Verbindung *T. spelta*  $\times$   $F_1$   $3(AB) + 2D + 4d$  sein, aber bei der Gegenkreuzung  $3(AB) + D + 2(4d)$ . Auf diese Weise bieten die Tabellen 4 und 5 eine Uebersicht über die Chromosomenzahlen und die Genomformeln in den Embryonen sowie Endospermen der in den beiden Rückkreuzungen sich ergebenden Körner.

Den Tabellen 4 und 5 sowie den Abbildungen 2–5 zufolge haben die Feststellungen über die Beziehung zwischen den Chromosomenzahlen des D-Genoms und der Entwicklung der Endospermen folgendes ergeben. In der Verbindung  $F_1 \times T. polonicum$  haben die Endospermen diploide (0–7)-Chromosomen des D-Genoms, während in der Kreuzung *T. spelta*  $\times$   $F_1$  sie mindestens 2 vollständige D-Genome aufweisen und die haploiden (0–7)-Dinkelchromosomen der  $3(ABD)$ -Genomen ihnen fehlen. In diesen beiden Kreuzungen mit diploiden (0–7)-Dinkelchromosomen fallen im allgemeinen alle Körner plump aus; deren Grösse betreffend, sind die Körner mit nur 2 vollständigen D-Sätzen am kleinsten, sie nehmen an Umfang zu Hand in Hand mit der Vermehrung bzw. der Verminderung der Dinkelchromosomen in *T. spelta*  $\times$   $F_1$  bzw. in  $F_1 \times T. polonicum$ . Hingegen zeigen in der Verbindung *T. polonicum*  $\times$   $F_1$  die Endospermen nur haploide (0–7)-Dinkelchromosomen, während in der Kreuzung  $F_1 \times T. spelta$  einige der 7 Chromosomen des D-Genoms haploid sind, andere triploid. In diesen Verbindungen mit haploiden (0–7)-Dinkelchromo-



TABELLE 4. Chromosomenzahl und Genomkonstitution der Embryonen sowie der Endospermen in den reziproken Kreuzungen von *T. polonicum*  $\times$   $F_1$

Embryonen ( $2n$ )	28 $2(AB)$	29 $2(AB)+d$	30 $2(AB)+2d$	31 $2(AB)+3d$	32 $2(AB)+4d$	33 $2(AB)+5d$	34 $2(AB)+6d$	35 $2(AB)+D$
Endo- spermen { <i>T. polonicum</i> $\times$ $F_1$ reziprok	42 $3(AB)$	43 $3(AB)+d$	44 $3(AB)+2d$	45 $3(AB)+3d$	46 $3(AB)+4d$	47 $3(AB)+5d$	48 $3(AB)+6d$	49 $3(AB)+D$
	42 $3(AB)$	44 $3(AB)+2(d)$	46 $3(AB)+2(2d)$	48 $3(AB)+2(3d)$	50 $3(AB)+2(4d)$	52 $3(AB)+2(5d)$	54 $3(AB)+2(6d)$	56 $3(AB)+2D$

TABELLE 5. Chromosomenzahl und Genomkonstitution der Embryonen sowie der Endospermen in den reziproken Kreuzungen von *T. spelta*  $\times$   $F_1$

Embryonen ( $2n$ )	35 $2(AB)+D$	36 $2(AB)+D+d$	37 $2(AB)+D+2d$	38 $2(AB)+D+3d$	39 $2(AB)+D+4d$	40 $2(AB)+D+5d$	41 $2(AB)+D+6d$	42 $2(ABD)$
Endo- spermen { <i>T. spelta</i> $\times$ $F_1$ reziprok	56 $3(AB)+2D$	57 $3(AB)+2D+d$	58 $3(AB)+2D+2d$	59 $3(AB)+2D+3d$	60 $3(AB)+2D+4d$	61 $3(AB)+2D+5d$	62 $3(AB)+2D+6d$	63 $3(ABD)$
	49 $3(AB)+D$	51 $3(AB)+D+2(d)$	53 $3(AB)+D+2(2d)$	55 $3(AB)+D+2(3d)$	57 $3(AB)+D+2(4d)$	59 $3(AB)+D+2(5d)$	61 $3(AB)+D+2(6d)$	63 $3(ABD)$

somen werden viel schlanke und runzelige oder eingeschrumpfte Körner erhalten, wobei die Runzeligkeit mit der Vermehrung bzw. der Verminderung der D-Chromosomenzahlen in *T. polonicum*  $\times$   $F_1$  bzw. in  $F_1 \times T. spelta$  zunimmt. THOMPSON (1930 a) teilte im grossen und ganzen ähnliche Resultate bei den Rückkreuzungen der pentaploiden Bastarde mit, wie schon in der Einleitung erwähnt wurde. In den Einzelheiten stimmen aber seine Resultate mit den gegenwärtigen nicht immer überein. Nach seiner Meinung<sup>(1)</sup> müssten z.B. die Endospermen mit den Formeln  $3(AB) + 2(4d)$  und  $3(AB) + 2D + 2d$  runzelig sein. In Wirklichkeit waren sie aber bei vorliegender Untersuchung dickkörnig, was zu unseren Theorie gut passt.

Die Keimfähigkeit der Körner ist im allgemeinen unabhängig von ihrer Grösse, wenn sie plump sind (vgl. WAKAKUWA, 1934). Wie aus Tabelle 3 hervorgeht, besitzen die plumpen Körner in der Verbindung *T. spelta*  $\times$   $F_1$  ein gutes Keimungsvermögen, sodass die Zeitdauer bis zur Keimung, ungeachtet der Grösse dieser Körner, kaum verschieden ist. Je runzeliger die Körner sind, um so später tritt jedoch in der Verbindung *T. polonicum*  $\times$   $F_1$  die Keimung auf. Viele runzelige oder eingeschrumpfte Körner besitzen ausserdem keine Keimfähigkeit. Die mehr oder weniger merkliche Runzeligkeit der Endospermen gelangt demnach gewöhnlich in keiner oder sehr geringerer Keimfähigkeit zum Ausdruck. Viele ungekeimte Körner und solche, die im Keimlingsstadium eingingen, wurden in den Kreuzungen  $F_1 \times T. spelta$  und *T. polonicum*  $\times$   $F_1$  nachgewiesen. Diese Körner müssen niedere bzw. höhere Chromosomenzahlen in  $F_1 \times T. spelta$  bzw. in *T. polonicum*  $\times$   $F_1$  haben, im Vergleich mit der geringen Keimfähigkeit der  $F_1$ -Körner in der Verbindung *T. polonicum*  $\varphi \times T. spelta$   $\sigma$ . Sie müssen nämlich Embryonen mit  $\pm 35$  Chromosomen und Endospermen mit der Formel  $3(AB) + (\pm D)$  haben. In der  $F_2$ -Generation des pentaploiden Bastards dürfte auch die im Vergleich mit der theoretischen Häufigkeit beobachtete Flachheit der Verteilung der 28- bis 42-chromosomigen Pflanzen zu einem Teil auf die Elimination dieser ungekeimten und weniger keimfähigen Körner als Ursache zurückzuführen sein (vgl. III. und V. Mitt.). Diese Elimination ist ebenfalls ein Kennzeichen der zygotischen Letalität, wie sie schon von KIHARA (1924), THOMPSON (1934) und MATSUMURA (1936 a) beschrieben wurde.

(1) Er schreibt „it is wrinkled or shrivelled when (a) it is haploid for all or many of the 7, (b) diploid or triploid for some only. The farther the chromosome situation departs from the complete absence or complete diploidy or triploidy of the vulgare chromosomes, the severer is the shrivelling“.

### Zusammenfassung

1. Die Beziehung zwischen der Chromosomenzahl und der Entwicklung der Endospermen in den Rückkreuzungen des pentaploiden Bastards *Triticum polonicum* L. var. *vestitum* KÖRN.  $\times$  *T. spelta* L. var. *Duhamelianum* KÖRN. zu beiden Eltern wurde in dieser Mitteilung näher untersucht.

2. Bei den Kreuzungen  $F_1 \times T. polonicum$  und  $T. spelta \times F_1$  waren fast alle Körner, die gewöhnlich eine bessere Keimfähigkeit aufwiesen, plump. Am kleinsten schienen die Körner bei den Endospermen mit gleicher Genomformel  $3(AB) + 2D$  zu sein, ähnlich wie bei den  $F_1$ -Samen in der Verbindung  $T. spelta \text{ ♀} \times T. polonicum \text{ ♂}$ . Die Grösse nimmt im allgemeinen mit der zahlenmässigen Verminderung bzw. Vermehrung der Dinkelchromosomen in  $F_1 \times T. polonicum$  bzw. in  $T. spelta \times F_1$  zu.

3. Hingegen wurden viel schlanke und runzelige oder eingeschrumpfte Körner bei den Kreuzungen  $T. polonicum \times F_1$  und  $F_1 \times T. spelta$  erhalten, die im grossen und ganzen keine oder nur eine geringe Keimfähigkeit besaßen. Die Abnahme der Runzeligkeit bei den Endospermen geht Hand in Hand mit der Vermehrung bzw. Verminderung der Chromosomen des D-Genoms in  $F_1 \times T. spelta$  bzw. in  $T. polonicum \times F_1$ . Die Körner mit pentaploiden Embryonen und heptaploiden Endospermen  $3(AB) + D$  waren am merklichsten runzelig oder eingeschrumpft, ähnlich wie bei den  $F_1$ -Samen der Kreuzung  $T. polonicum \text{ ♀} \times T. spelta \text{ ♂}$ .

4. In der Verbindung  $T. polonicum \times F_1$ , wo man viele runzelige Körner erhielt, war eine deutliche Korrelation zwischen der Chromosomenzahl und der Zeitdauer bis zur Keimung der Körner zu bemerken ( $r = +0.2952 \pm 0.0433$ ). Dagegen zeigte die Verbindung  $T. spelta \times F_1$  mit fast lauter plumpen Körnern keine Korrelation ( $r = -0.0999 \pm 0.0387$ ).

5. Demnach ist die Keimung der Körner nicht abhängig von der Grösse, wenn die Samen dickkörnig sind, sondern von der Runzeligkeit. Die ungekeimten sowie die zwar gekeimten aber im Keimlingsstadium eingegangenen Körner müssen im allgemeinen Embryonen mit  $\pm 35$  Chromosomen und Endospermen mit der Formel  $3(AB) + (\pm D)$  haben. Die zygotischen Eliminationen bei  $\pm 35$ -chromosomigen Pflanzen mögen zu einem Teil durch die Letalität dieser Körner hervorgerufen sein.

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# On the developmental change of quantities of chlorophyll and carotinoid in the leaves of rice-plant, barley, and wheat

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With 17 text-figures and 6 tables

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(Received July 18, 1938)

It can be understood from the colour-change of the leaves that the quantities of chlorophyll contained in them vary with the development of the plant. The research on this subject (1), (6)<sup>(1)</sup>, however, has not yet been performed fully. The similar change of carotinoid has been investigated by many researchers (1), (2), (6), and it has been said that their quantity increases accompanying the phase of reproduction. But this has not been established fully.

The object of the present experiments was to bring to light some points concerning these matters, and the materials used were rice-plant, barley, and wheat.

Three experiments were carried out: the first experiment was done with rice-plants in the season from summer to autumn in 1936; the second with barley and wheat in the season from winter to spring in 1937; the third with rice-plants again in the season from summer to autumn in 1937. The author intends in this communication to report<sup>(2)</sup> the results of the three experiments together.

## § 1. Material for experiment

Material for the first and the third experiments was the rice-plant of the variety called "Asahi" which was cultivated in the farm of the Kyūsyū Imperial University. Some life-records of the plant materials are shown in the following table:

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(1) Numerals enclosed within the brackets denote the literature cited at the end of the paper.

(2) The first and the second experiments were already reported in Japanese (cf. Syokubutu oyobi Dōbutu, Vol. 5, p. 945, and p. 1968). In the performance of the latter, Mr. NAKAHARA cooperated with the author.

TABLE I. The life-records of the rice-plant

		Sowing	Transplan- tation	Topdres- sing	Earing	Matura- tion	Harvest
Date	First experiment	May 27	July 8	Aug. 4	Sept. 9	Oct. 28	Oct. 31
	Third experiment	May 29	July 7	July 27	Sept. 5	Oct. 27	Oct. 29

Barley and wheat were employed as materials for the second experiment only. The variety of barley was "Takesita", and that of wheat was "Ezimasinriki". They were cultivated at a corner of the small infield of the University. The corner was sterile and purposely little manured. So, they, especially the barley, grew poorly. Their life-records were shown in Table II and Fig. 1.<sup>(1)</sup>

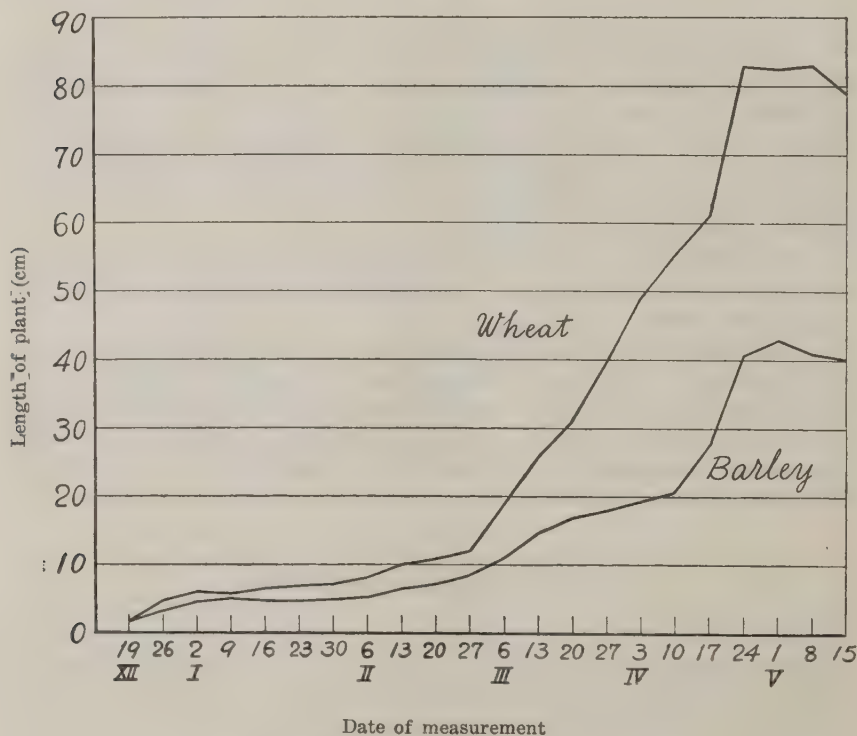


Fig. 1. The average length of twenty individuals

(1) In Figs. 1, 8-13, 15-17 the Roman and the Arabic numerals referring to the date denote the month and the day of each month respectively, e.g. XII=December, 19=19th.

TABLE II. The life-records of barley and wheat

		Sowing	Earing	Flowering	Harvest
Date	Barley	Dec. 8	Apr. 15	Apr. 22	May 20
	Wheat	Dec. 8	Apr. 20	Apr. 29	May 20

## § 2. The extraction and the quantitative measurement of plant-pigments

In measuring the quantity of the plant-pigments contained in leaves the first question which arises is what parts of the leaves should be taken as materials for the experiment. Their veins have usually been removed, and they are dried before extraction. In the present experiments, however, complete leaf-blades are taken, a bit of lower part being cut off. The extraction and quantitative measurement are performed weekly. The leaves are gathered in the morning of the day of experiment and carried to the laboratory in a test-tube. The plant-pigments are extracted from them within a short time. If the leaves are wet owing to rain and other causes, the dew-drops on them must be wiped away carefully with cotton-wool or gauze, when they are gathered.

The method of extraction and separation of the pigments is the same as that of WILLSTÄTTER and STOLL modified by SCHERTZ (5). The outline of the method is as follows:

2.5 gm of fresh finely chopped or cut leaves with a little sodium carbonate are put in a mortar, and mashed and ground thoroughly with some quartz sand mixed up. Adding a proper quantity of acetone, the whole is filtered through a BÜCHNER funnel. Pour ether into the filtrate and wash out acetone from the ether-acetone extract. The ether solution is poured into a bottle and  $\text{CH}_3\text{OH}$  is added, which has been saturated with KOH. After shaking thoroughly, set it aside over night until the chlorophyll is perfectly saponified and separated as a layer at the bottom of the bottle. The alkaline solution of chlorophyllin salt and carotinoid obtained is now poured into a separatory funnel and distilled water is added. After shaking strongly, the solution is left standing for from 15 to 30 minutes. Then the greenish chlorophyllin salt is run off in a volumetric flask. Thus we get the chlorophyllin solution and the ether solution of carotinoid. They are made up to a definite volume with water and ether respectively, and their concentration is measured by the method described below.



In the present experiments the spectrometric method is employed for the quantitative measurement of chlorophyll and carotinoid, and the absorption spectra of the solution of pigments are photographed. Roughly speaking, the absorption spectrum of the chlorophyll pigment has a remarkable absorption band in the region of red, and that of the carotinoid has an absorption region from green to violet. As their solution concentrates the absorption band of chlorophyll becomes broader, and the absorption edge in the green part of carotinoid moves towards the side of longer wave-length. From the above properties we can measure the concentration of solution of those pigments. Such method was employed in the first and the second experiment. Hereafter, we call it the first method.

The extinction coefficients of the solutions over some region or at a certain position of the spectrum can be measured by a suitable method, and their concentration is determined from the coefficients. This method was also employed in the third experiment. We call it the second method.

In both methods, the spectrum is photographed in the experiments. This is more profitable for such experiments lasting over many months, as in the author's case, than using the spectrometer or spectrophotometer (3), (4), (7). Details of the author's methods are as follows.

### (1) The first method

Firstly the relation between the width of the absorption band of chlorophyllin solution or the position of the absorption edge of carotinoid solution and their concentration is obtained, and the curve representing the relation is drawn. Examples of its are shown in Figs. 2, 3, and 4. Concentrations in the figures are not absolute but relating to a standard solution which is sufficiently concentrated and denoted by 100.

The datum pointed on the photographic plate is determined by the mercury spectrum taken in juxtaposition with the absorption spectrum of pigment-solution. It is not absolutely necessary that the measured position of the absorption edge is represented in wave-length. But, it is done with the dispersion curve for the sake of comparison with other experimental results.

The spectrograph with a photographic lens of 60 cm focal length gives on the photographic plate the dispersion of 0.0255, 0.0118, 0.0071, and 0.0045 mm per Å at 4000 Å, 5000 Å, 6000 Å, and 7000 Å respectively. The light source is the incandescent electric lamp of 100 watts fed by A. C. 100 V source. ILFORD panchromatic plates are used throughout the experiments. The time of exposure is 5 minutes for chlorophyll and 5 (in the first experiment) or 30 (in the second experiment) seconds for carotinoid.

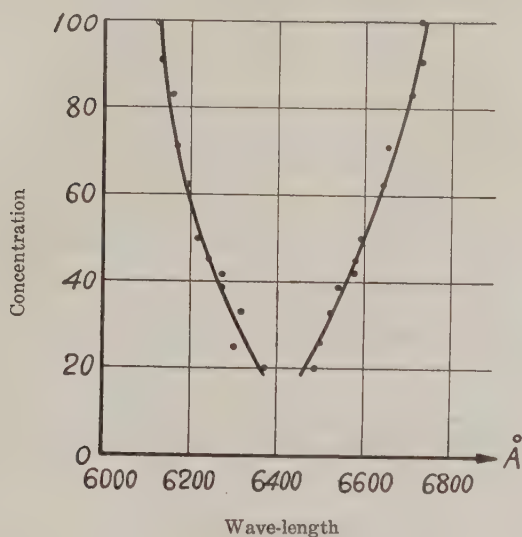


Fig. 2. The position of the absorption band of chlorophyll

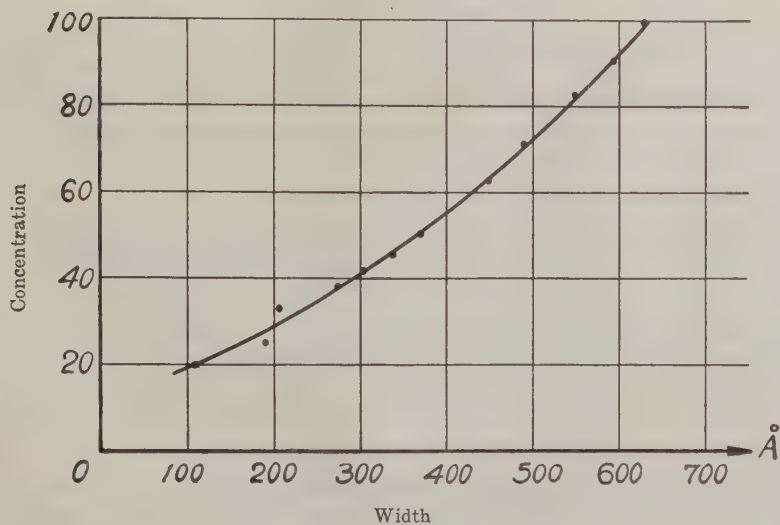


Fig. 3. The width of the absorption band of chlorophyll

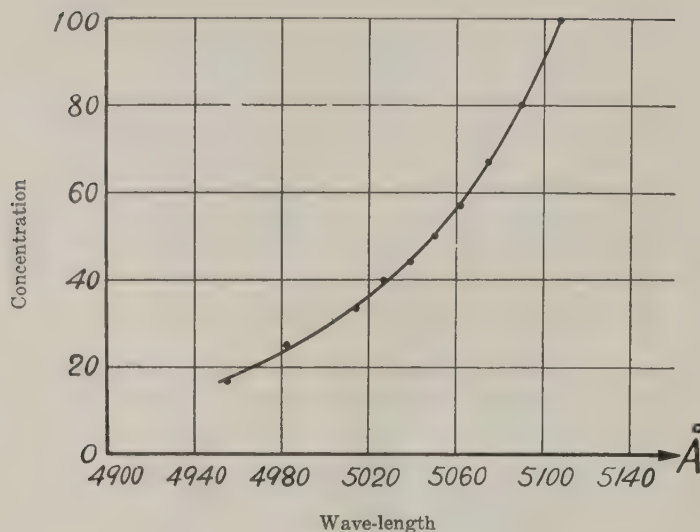


Fig. 4. The position of the absorption edge of carotinoid

## (2) The second method

The absorption spectra are photographed through a sector-photometer, the light source being an iron arc. From the plates, the extinction coefficients are determined or the extinction curves are drawn. As the thickness of trough was not accurately 1 cm, the true extinction coefficients were not obtained. But it is not a matter of consequence in the present case.

Firstly, we take the properly concentrated solution of plant pigments and measure its extinction coefficients. Dilute the solution step by step, and measure its extinction coefficients each time. From these results we can draw extinction curve for each solution of definite concentration. The standard curves thus obtained are shown in Figs. 5 and 6.

Besides, the following additional methods are performed for comparison.

(a). The concentration of pigment-solution is measured from the extinction coefficient at the line 5770 Å of mercury lamp. The standard curve in this case is shown in Fig. 7.

(b). The first method is also used, the light source being a point light electric lamp fed by 6 V D. C. and the time of exposure being 2.5 minutes for chlorophyll and 15 seconds for carotinoid.

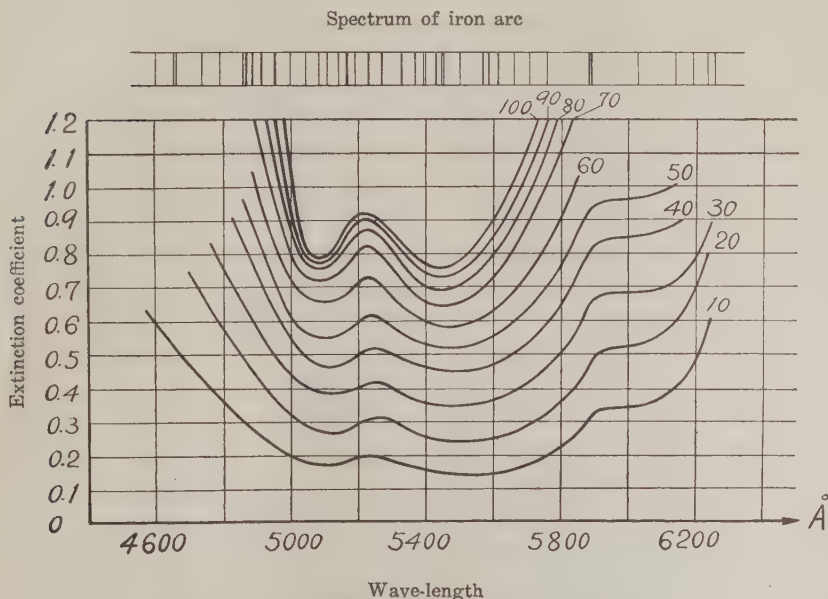


Fig. 5. The standard extinction curves of chlorophyll

### § 3. Experimental results

Experimental results are assembled in Table III and Figs. 8 and 9 for the first experiment, in Tables IV and V and Figs. 10~13 for the second experiment, in Table VI and Figs. 14~17 for the third experiment. It must be remarked that the concentrations described in those tables and figures are not the true concentrations but the provisional ones relating to a certain solution selected as the standard, its concentration being indicated as 100.

The meteorological elements are added in the tables or figures for the comparison with the change of the quantity of plant pigments. "Pigment-quantity of dry leaves" described in some tables and figures is to be explained later.

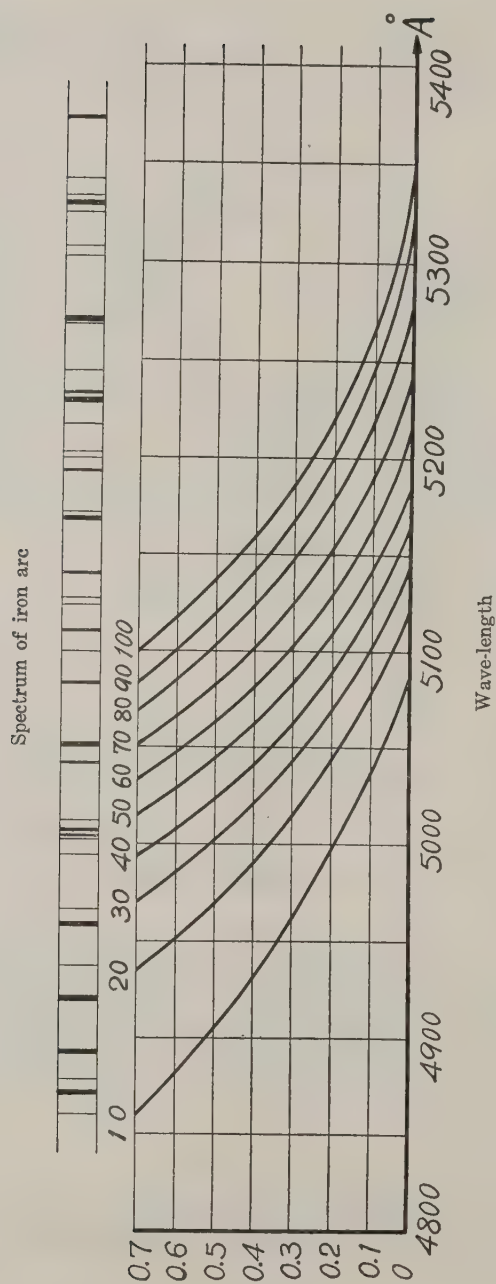


Fig. 6. The standard extinction curves of carotinoid



TABLE III. The pigment-quantities of rice-plant and the meteorological elements

Date of gathering leaves	The day at question (A.M. 10)		Previous day			Total sunshine hours in the preceding week	Chloro-phyll	Caroti-no'id	Mean atmospheric temp. of the day of photograph c development (°C)
	Weather	Temp. (°C)	Weather (A.M. 10)	Mean temp. (°C)	Transpira-tion (mm)	Sunshine hours			
July 7	☉	23.0	●	21.4	(0)	—	29	45	24.1
14	①	23.2	○	22.5	—	9.4	49	53	27.6
21	○	31.4	①	27.5	5.1	10.7	78	61	26.3
28	①	31.5	○	30.7	6.2	11.4	89	100	28.2
Aug. 4	☉	29.4	●	—	(0)	0.3	100	98	27.3
11	①	31.1	☉	27.9	4.6	5.9	94	79	29.5
18	☉	25.6	☉	24.6	—	—	76	61	24.2
25	○	31.3	①	23.6	4.8	5.5	63	58	27.5
Sept. 1	☉	29.5	☉	23.9	—	1.1	78	83	27.2
8	○	23.7	○	27.1	4.4	10.7	73	75	27.8
15	☉	25.5	☉	28.0	(5.5)	2.6	76	99	21.0
22	①	25.0	①	20.9	6.8	8.9	65	85	20.7
29	○	24.3	①	17.5	2.5	5.2	68	93	20.7
Oct. 7	☉	19.1	①	16.8	—	7.8	32	48	16.0
13	①	21.8	☉	20.5	2.7	0.5	35	56	16.8
20	☉	20.0	☉	18.5	2.0	—	29	51	17.3
27	①	16.5	①	16.9	2.1	5.3	16	47	11.8

Symbols for weather

○ ① ☉ ●  
 fine fair cloudy rain

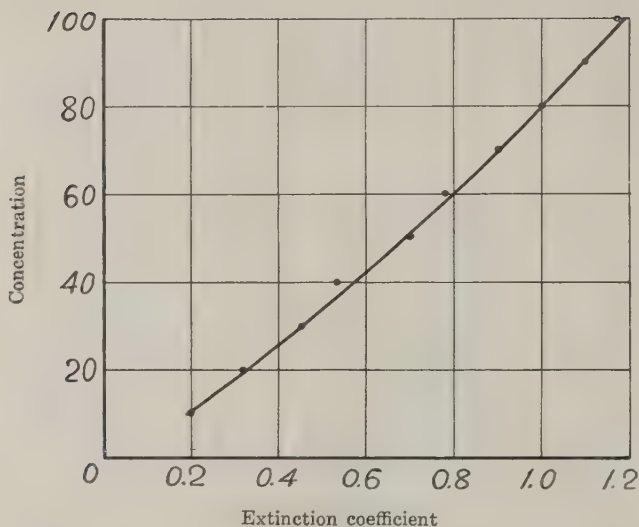


Fig. 7. The standard curve of extinction coefficient at the line 5770 Å

TABLE IV. The pigment-quantities of barley.

Date of gathering leaves	Dry quantity in 100 fresh leaves	Chlorophyll		Carotinoid	
		For fresh leaves	For dry leaves	For fresh leaves	For dry leaves
Feb. 24		83		70	
Mar. 4		94		83	
	11	17.0	100	100	100
	18	19.7	84	72	69
	25	15.9	72	77	67
Apr. 1	17.1	70	70	50	50
	8	17.7	60	58	27
	15	16.3	57	60	21
	22	19.4	57	50	13
	29	22.4	69	52	52
May 6	20.0	55	47	18	15
	13	22.5	48	36	17

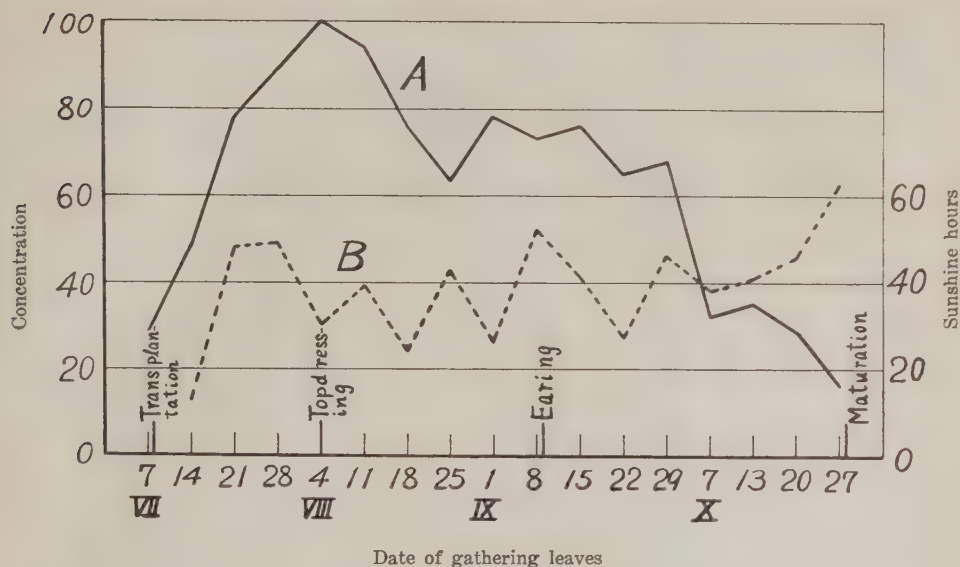


Fig. 8. The variation of the quantity of chlorophyll and sunshine hours  
 Curve A represents the variation of the quantity of chlorophyll  
 Curve B represents the variation of total sunshine hours in the preceding week

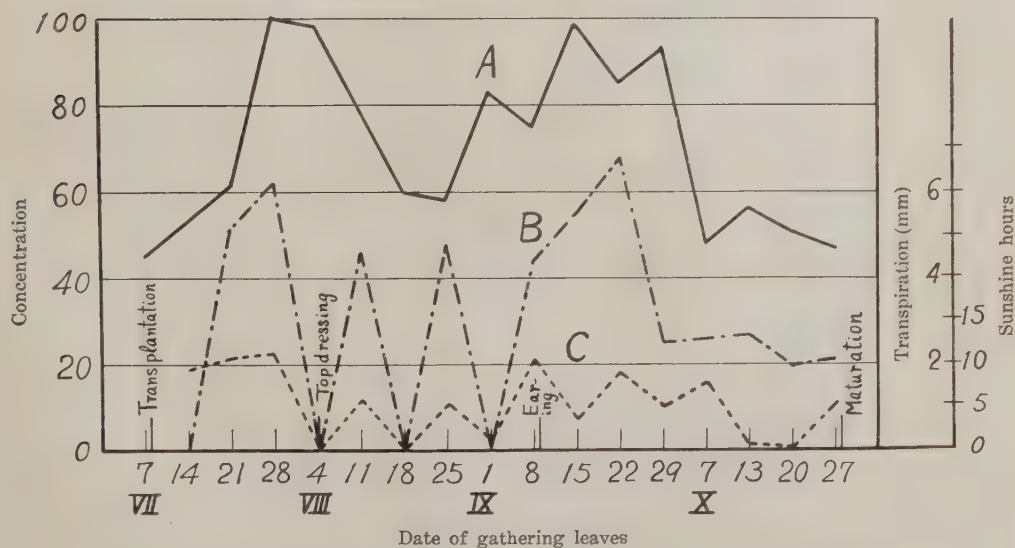


Fig. 9. The variation of the quantity of carotinoid, sunshine hours and transpiration  
 Curve A represents the variation of the quantity of carotinoid  
 Curve B represents the transpiration of the previous day  
 Curve C represents the sunshine hours of the previous day

TABLE V. The pigment-quantities of wheat

Date of gathering leaves	Dry quantity in 100 fresh leaves	Chlorophyll		Carotinoid	
		For fresh leaves	For dry leaves	For fresh leaves	For dry leaves
Feb. 24		76		36	
Mar. 4		92		92	
11	28.1	98	79	100	78
18	22.7	100	99	81	78
25	20.2	92	100	92	100
Apr. 1	22.0	89	91	57	57
8	20.8	62	67	51	54
15	20.5	61	67	30	32
22	24.6	55	50	25	22
29	27.8	50	40	25	20
May 6	31.3	69	50	40	28
13	33.1	38	26	19	13

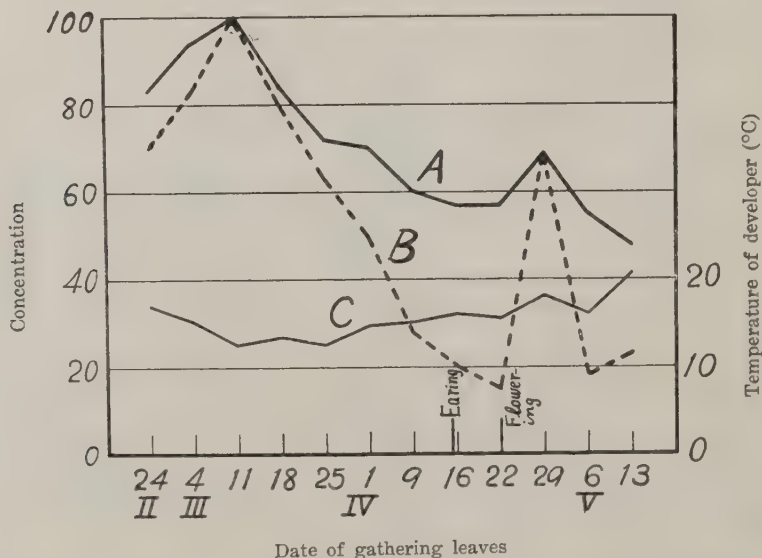


Fig. 10. The variation of the quantity of pigments of barley (for fresh leaves)  
 Curve A represents the variation of the quantity of chlorophyll  
 Curve B represents the variation of the quantity of carotinoid  
 Curve C represents the temperature of developer

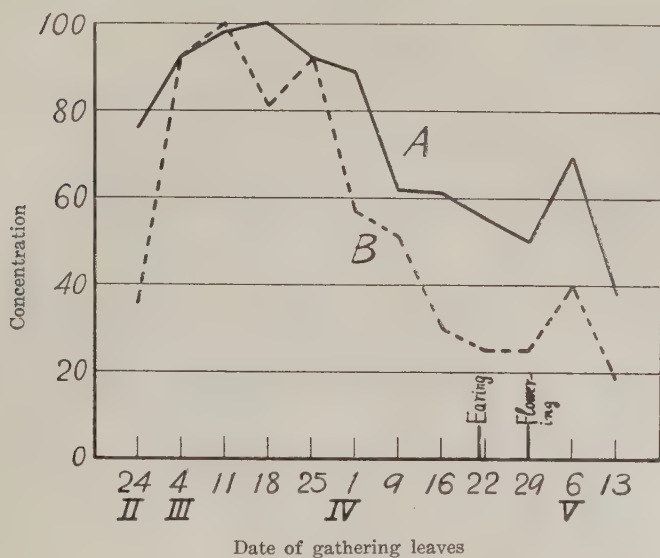


Fig. 11. The variation of the quantity of pigments of wheat (for fresh leaves)  
Curve A represents the variation of the quantity of chlorophyll  
Curve B represents the variation of the quantity of carotinoid

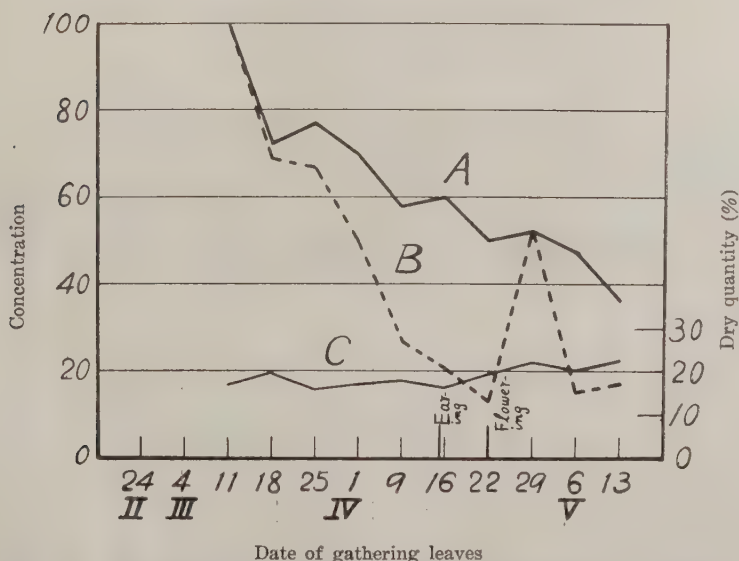


Fig. 12. The variation of the quantity of pigments of barley (for dry leaves)  
Curve A represents the variation of the quantity of chlorophyll and  
Curve B, that of carotinoid  
Curve C represents the dry quantity in 100 fresh leaves



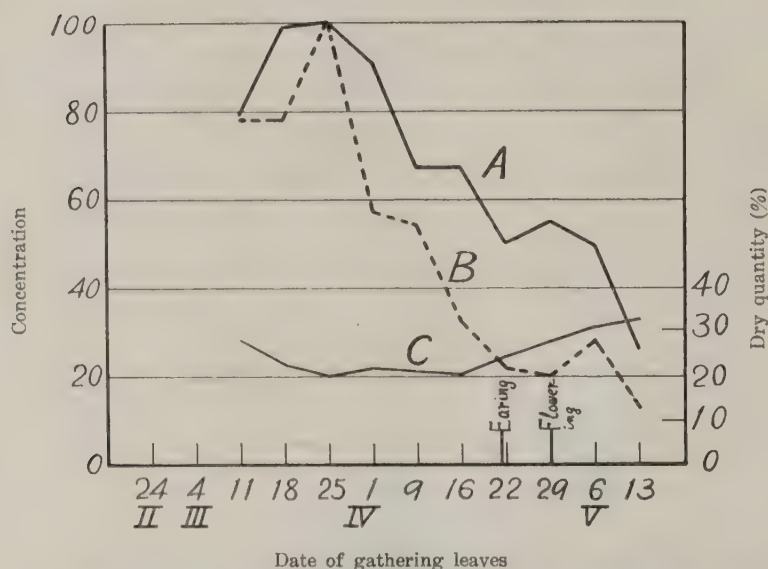


Fig. 13. The variation of the quantity of pigments of wheat (for dry leaves)

Curve A represents the variation of the quantity of chlorophyll and Curve B, that of carotinoid

Curve C represents the dry quantity in 100 fresh leaves

TABLE VI. The pigment-quantities of the rice plant

Date of gathering leaves	Chlorophyll (for fresh leaves)			Carotinoid (for fresh leaves)		Dry quantity in 100 fresh leaves	Total sunshine hours in the preceding week
	From extinction curve	From absorption band.	From extinction coef.	From extinction curve	From absorption edge		
Aug. 10	69	66	72	63	60		46.50
17	64	69	68	74	75		55.20
24	40	59	42	67	63	30.2	46.55
31	30	48	34	35	46	34.6	62.40
Sept. 7	36	53	38	44	50	35.0	71.50
14	31	45	26	50	58	35.7	24.55
21	27	44	22	61	63	35.3	31.25
28	25	46	26	50	47	37.0	35.00
Oct. 5	13	26	10	55	49	36.5	26.75
12	5	20	7	25	37	34.3	24.50
19	3	18	4	27	44	38.7	25.70

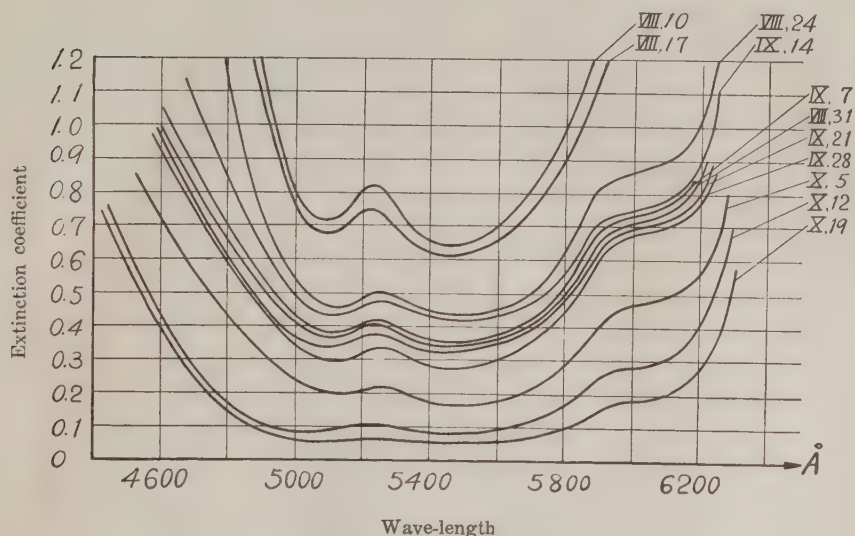


Fig. 14. The extinction curves of chlorophyll obtained in the third experiment

#### § 4. Discussion of the results

From the results of the first experiment, i.e. Figs. 8 and 9, we see that the quantitative variation curves of chlorophyll and carotinoid represent two maxima. The first maximum coincides with the season of the most vigorous growth of the plant and the second maximum is of more interest. It falls on and after the earing. So, it might be considered that the chlorophyll and carotinoid increase their quantities once more as the plants enter the phase of reproduction, and the second maximum is more remarkable for the carotinoid.

There are, however, some doubt about the nature and the cause of the second maximum; the topdressing or the meteorological elements might be responsible for the phenomenon; or it could be taken as the result of mere fluctuation or error of measurement. We shall now discuss such points, referring to the results of the third experiment.

We see from Figs. 16 and 17, which indicate the results of the third experiment, that similar results are attainable by two or three different methods of measurement. The first method, which is employed in the first and second experiments, involves several possible sources of error, concerning the luminosity of the light source, time of exposure, sensibility of photographic plate, temperature of developer, time of developing and so

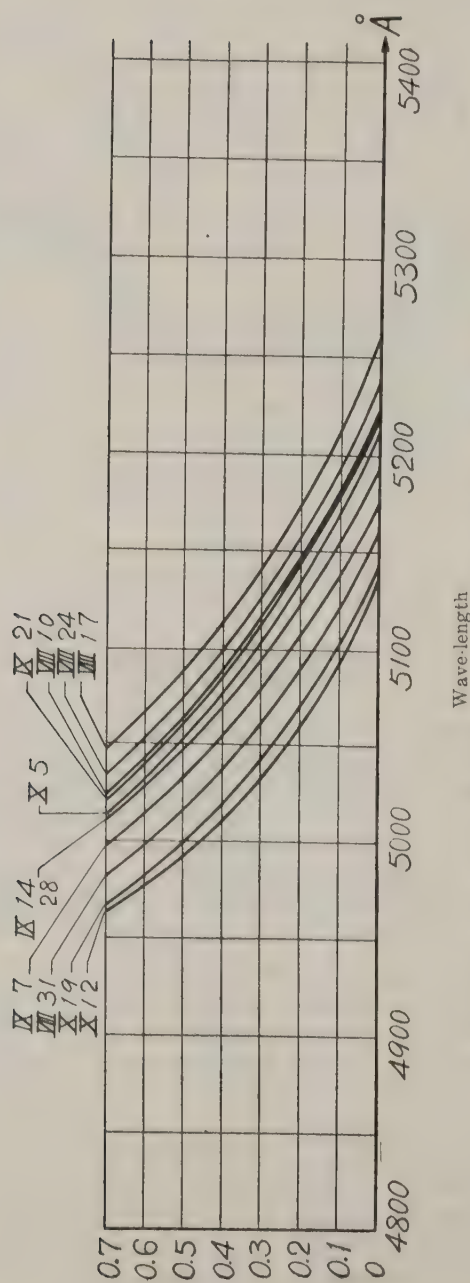


Fig. 15. The extinction curves of carotinoid obtained in the third experiment

on. But in the second method employed in the third experiment, there is a question whether the lights which pass through the two window of the sector-photometer give the same intensity on the photographic plate or not when no solution is found in the absorption vessel.

In the first experiment, the temperature of the developer was not recorded, though we examined the change of room temperature and the

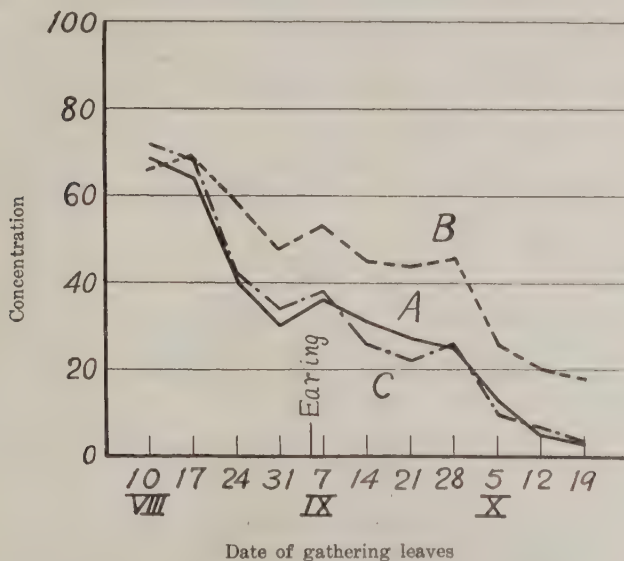


Fig. 16. The variation of the quantity of chlorophyll of rice-plant (for fresh leaves)

Curve A represents the result obtained from extinction curve

Curve B represents the result obtained from absorption band

Curve C represents the result obtained from extinction coefficient at the line 5770 Å

spectra of light source photographed on each plate under the exposure of the same time duration, i.e. 5 sec. In the second experiment, the temperature of the developer was recorded and examined. From these examinations, it was concluded that the possible error arising from the temperature of developer was negligible. Furthermore, we used the second method with the sector-photometer in the third experiment, and as our results obtained by the two methods are nearly the same, they are considered reliable.

Now, comparing the results of the third experiment with that of the first experiment, we see that the second maximum of carotinoid is self-evident, but that of chlorophyll is somewhat uncertain. So we are able

to insist in the present situation the existence of the second maximum for carotinoid only.

Next we shall search the cause or meaning of the second maximum. As the interval between the date of topdressing and the beginning of the second hump is too long—namely 3 weeks in the first experiment, and 5 weeks in the third, the topdressing can not be considered as the cause of the second hump, though it makes the growth of the plants somewhat vigorous. The true cause, therefore, must be sought elsewhere.

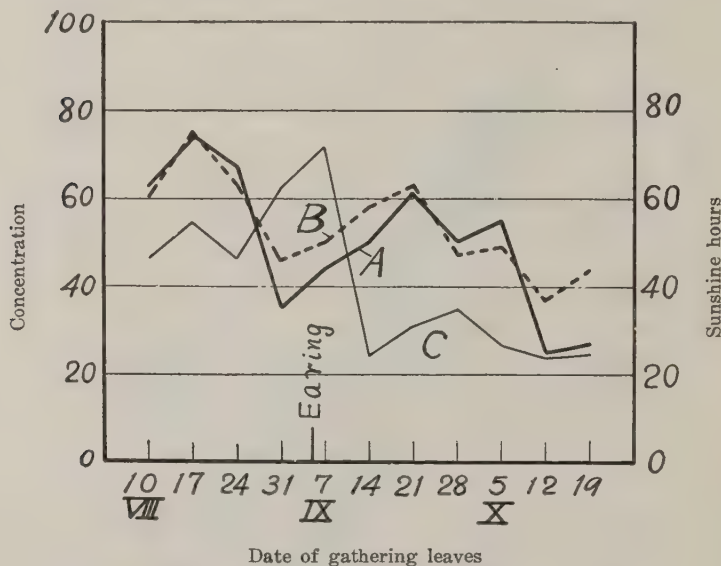


Fig. 17. The variation of the quantity of carotinoid of rice-plant (for fresh leaves)

Curve A represents the result obtained from extinction curve

Curve B represents the result obtained from absorption edge

Curve C represents the total sunshine hours in the preceding week

Meteorological elements possibly influence the change of the quantity of plant-pigment. But we could not find any definite correlation between them, and it can not be said that the second hump is caused only by the change of the meteorological elements.

In the second experiment the growth of barley and wheat was too poor, and the quantity of plant-pigment does not fluctuate remarkably, but decreases almost steadily and monotonously. Nevertheless, the carotinoid clearly shows the second hump.



From the above consideration, the existence of the second hump is certain in the case of the carotinoid. Yet, there is the question about the water content of leaves and the dual components of chlorophyll and carotinoid— $a$  and  $b$  or  $\alpha$  and  $\beta$ . In the present experiment, the materials for experiment were the fresh leaves and the change of water content with the change of season might cause the second hump. So, the water content was measured; in the second experiment, about 1 gm of fresh leaves was weighed accurately and put in a thermostat at 100°C, and after a whole day weighed again; in the third experiment, 2 gm of fresh leaves were put in a desiccator for a long time and weighed again. Thus the water content and dry weight were calculated.

Let the quantity of pigment in fresh leaves (in relative concentration) be  $c$ , and the dry weight of 100 fresh leaves  $d$ , and we obtain the quantity of pigment for dry leaves, that is,

$$c' = \frac{c}{d}.$$

These values are recalculated in order that the greatest value becomes 100. Thus we get "the pigment-quantity of dry leaves".

From these considerations, it is concluded that the variation of water content is not so effective as to cause the second hump in the variation of pigment quantity.

There are two kinds in both chlorophyll and carotinoid i.e.  $a$  and  $b$ , and  $\alpha$  and  $\beta$  respectively. And their absorption spectra are similar but somewhat different. So the above discussion postulates implicitly that their ratio does not vary so remarkably, as the separation of the dual components is not performed in the present experiments. This question has not been researched fully so far as the author knows. But seemingly the variation of ratio could be neglected in the experiments.

## Summary

1. The developmental variation of the quantity of chlorophyll and carotinoid contained in leaves of rice-plant, barley, and wheat is studied.
2. The method of extraction of the pigments is the same as that of WILLSTÄTTER-STOLL modified by SCHERTZ, and spectroscopic method is employed to measure their quantities.
3. The results are as follows:—

The quantitative variation-curve of carotinoid pigment represents two maxima. The first falls on the season of the most active growth of the plant, and the second corresponds to the phase of reproduction.

Chlorophyll pigments show the similar properties of variation, but the second hump of increase is somewhat uncertain.

In conclusion, the author wishes to express his gratitude to Professor S. SUZUKI for his kind guidance and to Professor T. MORINAGA for his discussion. He is also indebted to Mr. M. NAKAHARA for his full cooperation and kind help in some of the present experiments.

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## Notes on the effects of alcohol and acetic acid on spermatogenesis in *Isoetes japonica* AL. BR.

By Akira YUASA

The microspores of *Isoetes japonica* AL. BR. are very resistant to drying. Even the microspores in one nucleate stage which have been dried up completely for a few days are able to continue the course of spermatogenesis and to complete four spermatozoids within them, when they are put in water. The putting of the dried microspores into water seems to stimulate the course of spermatogenesis (YUASA 1933).

In this paper the effects of alcohol (ethyl-alcohol) and acetic acid on spermatogenesis in *Isoetes japonica* AL. BR. will be briefly reported. The microspores were collected from the plants growing in the suburbs of Tokyo. The microspores which were in one nucleate stage were put into alcohol or acetic acid of a certain strength for a certain number of minutes or hours, and then put into tap water; and each day the microspores which had been thus treated with alcohol or acetic acid were observed under the microscope to determine the stage of development reached by them. To make the completed spermatozoids extrude out from the microspores FUJII's method (1925) was employed. Every day some of the microspores which had been treated with alcohol or acetic acid and put into tap water were also fixed with chrom-acetic acid solution, cut into  $8\mu$  thickness according to the paraffin-method, and stained with HEIDENHAIN's iron-alum haematoxylin in order to study the course of spermatogenesis cytologically.

As shown in Table I<sup>(1)</sup>, alcohol of low percentage seems to accelerate the course of spermatogenesis. When treated with alcohol of a low percentage for a long time, however, the course of spermatogenesis seems to be retarded. When alcohol of higher percentage is applied the course of spermatogenesis is also retarded.

0.5% acetic acid hardly hinders the course of spermatogenesis, but retards it somewhat. When treated with 5% acetic acid for 10 minutes the course of spermatogenesis is not retarded, but when treated for 20 minutes or more it is. 10% acetic acid retards the course of spermatogenesis even when it is applied for only 10 minutes; while 10% acetic acid

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1) Table I shows several experiments in only one case.

TABLE I  
Effects of alcohol on spermatogenesis in *Isoetes japonica* AL.Br.

Percentage of alcohol	Time of treatment (hours)	14/Oct.	15/Oct.	16/Oct.	17/Oct.	21/Oct.	27/Oct.	4/Nov.	19/Nov.
0.5%	5	Put in tap water	—	+	+	+	++	++++	++++
"	10	"	—	—	—	+	++	++++	++++
"	15		Put in tap water	—	—	—	++	++++	++++
"	20		"	—	—	—	+	++++	++++
"	24				Put in tap water	—	—	++++	++++
5%	10		Put in tap water	—	—	++	++	++++	++++
"	15		"	—	—	—	+	++++	++++
"	20		"	—	—	—	+	++++	++++
"	24			Put in tap water	—	—	+	++++	++++
Control (in tap water)			Put in tap water	—	—	—	+	++++	++++
Percentage of alcohol	Time of treatment (hours)	20/Nov.	26/Nov.	30/Nov.	6/Dec.	23/Dec.	31/Jan.		
10%	1	Put in tap water	+?	+?	+	++++	++++		
"	5	"	+?	+?	+	++++	++++		
"	8	"	+?	+?	+	++++	++++		
"	10	"	+?	+?	+	++++	++++		
Control (in tap water)		"	—	—	+	++++	++++		

(1937-1938)

++++ = A great many spermatozooids are extruded out from the microspores by FUJII's method.

++ = Many spermatozooids are extruded.

+ = A few spermatozooids are extruded.

+? = Very small number of spermatozooids are extruded.

— = No spermatozooids are extruded.

TABLE II

Effect of acetic acid on spermatogenesis in *Isoetes japonica* AL.BR.

Percentage of acetic acid	Time of treatment (hours)	14/Oct.	15/Oct.	16/Oct.	17/Oct.	21/Oct.	27/Oct.	4/Nov.	19/Nov.
0.5	5	Put in tap water	—	—	—	—	—	++++	++++
„	10	„	—	—	—	—	—	++++	++++
„	15		Put in tap water	—	—	—	—	++++	++++
„	20		„	—	—	—	—	++++	++++
„	24				Put in tap water	—	—	++++	++++
5%	(minutes) 10		Put in tap water	—	—	—	+	++++	++++
„	20		„	—	—	—	—	++++	++++
„	30		„	—	—	—	—	++++	++++
„	60		„	—	—	—	—	—	+
Control (in tap water)			„	—	—	—	+	++++	++++
Percentage of acetic acid	Time of treatment (minutes)	20/Nov.	26/Nov.	30/Nov.	6/Dec.	23/Dec.	31/Jan.		
10%	10	Put in tap water	—	—	—	++++	++++		
„	20	„	—	—	—	++++	++++		
„	30	„	—	—	—	++	++		
„	60	„	—	—	—	—	—		
Control (in tap water)		„	—	—	+	++++	++++		

(1937-1938)

++++ = A great many spermatozooids are extruded out from the microspores when treated by FUJII's method.

++ = Many spermatozooids are extruded.

+ = A few spermatozooids are extruded.

— = No spermatozooids are extruded.



completely kills the microspores when applied for 1 hour. Table II shows the results of several experiments.

It is generally said that the course of spermatogenesis is accelerated by the effect of alcohol of low percentage, but retarded by that of acetic acid.

Judging from the results mentioned above it is necessary to employ alcohol or acetic acid of, at least, 10 percent or higher in order to fix the microspores with either alcohol or acetic acid.

The spermatozooids which have extruded out from the microspores thus treated with alcohol or acetic acid show no abnormal variations in their size and structure. Sometimes, however, the spermatozoid-body becomes very slender and the head becomes large. In other cases, the border-brim is somewhat shorter or thicker than that of a normal spermatozoid. Therefore the course of spermatogenesis is thought to proceed normally with but few exceptions.

Indeed the cytological study of fixed and stained materials which have been treated with alcohol or acetic acid shows no abnormality in the course of spermatogenesis.

The multipolar mitoses were observed by some authors (ZIEGLER 1903, POLOWZOF 1923, 1924) in the eggs of a sea-urchin which had been treated with alcohol. This fact means that alcohol affects the division of the centrosome being followed by multipolar mitoses. As stated above, in the experiments worked out by the writer, however, alcohol affects the border-brim in such a way as to show some morphological variations; the border-brim is a part of the blepharoplast which is thought to be homologous with the centrosome (YUASA 1934, 1938). From these facts some sort of a relation is suggested between the border-brim and the centrosome.

According to KOSTOFF and HADJIDIMITROFF (1931) the spermatogenesis of a rabbit is greatly affected by the injection of alcohol into the body, and many abnormal spermatozoa are produced. KOSTOFF (1929/30) also succeeded in producing abnormal plants by crossing the plants which were treated with alcohol (after KOSTOFF and HADJIDIMITROFF 1931). According to the writer's experiments on *Isoetes japonica* AL. BR., however, abnormal spermatozooids were not produced with the exception of a few cases when alcohol were employed.

## Summary

The course of spermatogenesis in *Isoetes japonica* AL. BR. is accelerated by the effect of alcohol of a lower percentage, while it is retarded by the effect of acetic acid. The spermatozooids which have been

extruded out from the microspores thus treated show almost no structural changes.

The course of spermatogenesis in the treated microspores proceeds normally.

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# Anomalous secondary growth in the axis of *Bauhinia Championi* BENTH.<sup>(1)</sup>

By Tsugio HANDA

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With plate V and 2 text-figures

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(Received July 23, 1938)

*Bauhinia Championi* is indigenous to Formosa and China, and its axis is satisfactorily used in making small articles such as tobacco-boxes or tea-saucers on account of its possessing a beautiful rosette pattern appearing in sections. Such patterns, arising as a result of anomalous secondary growth, often differ greatly in their design according to the axes observed. However they are formed in every case in the same course of development.

In this paper, mainly the developmental course of the pattern as a product of anomalous secondary growth will be considered by means of serial arrangement of different stages in the anomalous growth.

Used as material were many segments and discs of axis of different thickness, all collected in Formosa by Prof. Y. OGURA. It is my pleasant duty to express to him my hearty thanks for the material as well as for the guidance with which he favoured me during the course of this investigation.

## Development of anomalous structure

The anomalous structure of *B. Championi* is a combination of two different types of anomalous structures, namely of the cleft xylem-mass and of the successive rings or groups of wood and bast. At first the two types will be separately considered in the light of their development.

1) *Cleft xylem-mass*. Slender axes are still normal in secondary thickening, but somewhat flattened on both sides corresponding to the leaf-orthostichies, as a result of weaker cambial activity on these sides.

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(1) Contributions from the Divisions of Plant-Morphology and of Genetics, Botanical Institute, Faculty of Science, Tokyo Imperial University, No. 211.

Such a flattening of the axis is liable to appear in combination with the waving of the axis. The wood is clearly distinguishable into the axial and periaxial woods, the former consisting almost exclusively of wood-fibers and narrow vessels, in contrast to the latter's composition of wood-fibers, far wider vessels and a large amount of parenchyma, while the outer margin of the whole wood is provided with many furrows of varying depth, the formation of which is not always due to the presence of a broad ray. The pith, as seen in a cross section, is of cruciate shape (plate-fig. 1). These features connected with normal secondary growth are very common in the lianes; and, so far as the normal secondary growth is concerned, no differences are found between the present species and *B. japonica* dealt with in my previous paper (1937).

The anomalous secondary growth is soon (for instance in an axis of 1.3 cm. thickness) begun with a dilatation occurring in the pith—especially on its periphery—as well as in the wood. This dilatation leads to a splitting up of the xylem-mass into several segments. In this case, cleaving is liable to occur in such radii as pass through the marginal furrows of the wood. Next (for instance in an axis of 1.5 cm. thickness) there arise in the medullary dilata-

tion-parenchyma several small bundles, each one provided with xylem and phloem. Plate-fig. 2 shows a start being made in the differentiation of such bundles. While these bundles are growing larger by the action of their own cambium, the dilatation in the pith and wood is also continued, so that it gives rise at last to a considerably large area of dilatation-parenchyma.

On the other hand, the separate wood-segments become provided on their radial sides with a strip of cambium, which is continuous with the original cambium lying on the outer side of the segments. Thus each segment becomes surrounded by a continuous ring of cambium, which is



Text-fig. 1. Illustrative cross section of a thickened axis. Phloem parts outlined by dots; wood-segments shown white and xylem parts of secondary bundles shown in solid black: fragments of the ring of axial wood indicated by arrows. Small bundles belonging to the first, secondary ring of wood and bast are also seen towards the periphery. (Cf. plate-fig. 4) ( $\times 2/3$ )



only interrupted on its inner side (plate-fig. 3). Under such conditions no elements can be added on the inner side of the segments, while on the remaining sides a considerable amount of elements is uniformly produced by the cambium. Hence the segments grow larger in the shape of unfolding fans.

Generally the fragments of axial wood come to be separated from the wood-segments owing to the development of an intervening dilatation-parenchyma, but even in later stages they are distinguishable among a complicated system of the cleft xylem-mass.

Sooner or later the wood-segments and secondary bundles become connected in groups by their cambium, in such a manner that each group contains one segment and a few secondary bundles. In addition to these groups, there are found several smaller ones consisting of secondary bundles alone. Text-fig. 1 is a diagrammatic reproduction of plate-fig. 4, a transverse view of a thickened axis. The outline of the groups in question is dotted; and the xylem parts of the secondary bundles are shown in solid black. Scattered fragments of the ring of axial wood are also indicated by arrows. The stage shown in this figure is regarded as a fully advanced one in the formation of the cleft xylem-mass.

The secondary bundles and the branches from the wood-segments anastomose with one another in the longitudinal direction, not only within one and the same group but also among different ones; though the latter anastomosis is only of rare occurrence. Owing to such anastomosis the cleft xylem-mass, as seen in cross sections, is often fairly dissimilar in design at different heights of an axis.

2) *Successive development of rings of wood and bast.* In thickened axes, generally, on the outer side of the wood-segments mentioned above there is found a secondary ring of wood and bast, which in most cases is not continuous but broken into segments of different lengths. In text-fig. 1 we can see many short segments of this nature, but in plate-fig. 5 photographed from another axis such forms are manifested far more satisfactorily.

Of the segments composing the secondary ring of wood and bast, the short ones show a strong tendency to be surrounded, each one separately, by a cambium. On the inner side of the short segments, however, the cambium does not appear to be in exact juxtaposition to the xylem, but somewhat apart from it, namely in a region of parenchyma. The activity of the small cambium rings thus formed gives rise to the concentric bundles, all belonging to the same secondary ring of wood and bast. The formation of these small cambium rings is somewhat comparable to that of the separate cambium rings in the cleft xylem-mass. Plate-fig. 6 shows one of the concentric bundles magnified from plate-fig. 5. The

xylem part is quite encircled by the phloem. These bundles anastomose with one another in the longitudinal direction.

The sections above-cited exhibit only one secondary ring of wood and bast, but we not infrequently meet with an axis of a type that shows two secondary rings, the first and the second, which are separated from each other by a layer of parenchyma. In text-fig. 2 the first, well marked and the second, far narrower rings are seen. The first ring consists of a number of short and far longer segments. The short segments are all the so-called concentric bundles, though their centers lean considerably towards their inner side. Internal to the long segments, also, there are



Text-fig. 2. Cross section of a thickened axis, showing two secondary rings (I, II) around a cleft xylem-mass. W, wood-segment; A, fragment of the ring of axial wood; S, secondary bundle in the dilatation-parenchyma. ( $\times 1$ )

found many extremely small bundles of inverse orientation, which have been produced by the cambium arising there. The same applies to the second ring also.

The secondary meristems to form the successive rings of wood and bast seem, as in other *Bauhinia*, to originate in the pericyclic parenchyma, this being inferred from the fact that the ring of pericyclic sclerenchyma is always located externally to the last formed ring of wood and bast.

It is considered that, when the first ring of secondary meristem begins to appear, all the cambium relating to the formation of the cleft

xylem-mass has quite ceased to function; but without further investigations we cannot say whether the first ring is still active at the time when the second one has been laid down, or whether it has already ceased to function.

### Comparison with other cases

In an axis of *Bauhinia angulosa* VOG. showing a secondary ring of wood and bast, SCHENCK observed narrow, radial and tangential bands of dilatation-parenchyma in the inner part of the periaxial wood, and he said that in older axes the process of dilatation might be so advanced as to cleave the wood, and that, then, two different types of anomaly, the successive development of groups of wood and bast and the cleavage of the xylem-mass, would be combined in the same axis. Even if such a combination of anomalous types should actually be the case, the cleavage of the xylem-mass, as is apparent from the above, will occur subsequently to the successive development of groups of wood and bast. In *B. Championi*, on the contrary, the latter anomalous growth begins for the first time only when the former one has almost reached completion, and moreover both of the anomalous structures are, not doubtfully but very distinctly exhibited in the thickened axes.

A combination structure of these anomalies is also represented by SCHLEIDEN in a transverse section of a supposed *Bauhinia* species, a reproduction of which is given in DE BARY's textbook. The outline of his figure strongly resembles that of the present species, but we are without information on the course of development of that structure.

In certain *Bauhinia* species possessing the cleft xylem-mass, it is known that the wood-segments, formed by radial splitting of the wood, are further cleft in a tangential direction into small parts, each of which soon becomes encircled by a cambium. In *B. Championi* such a tangential cleaving of the wood-segments is not shown at all, but instead, secondary bundles are abundantly differentiated in the medullary dilatation-parenchyma and their progressive enlargement through action of the cambium plays an important rôle in the formation of the cleft xylem-mass.

As regards the cleft xylem-mass, hitherto reported, the ring of axial wood generally remains unaffected, and even when it is split up, the differentiation of secondary bundles, in most cases, does not occur in the region interior to the ring. Though bundles of such location are seen in SCHENCK's figure of *Bauhinia* sp. and also in SCHLEIDEN's figure of a supposed *Bauhinia* species, their participation in the construction of the cleft xylem-mass is not important when compared with the case of the present species.

*Bauhinia japonica* is also known to us as a species which differentiates secondary bundles on the inner side as well as on the outer side of the ring of axial wood; however, in this plant, so far as the material used is concerned, the differentiation of cambium is not found to occur on the radial sides of the wood-segments. Besides, on the other hand, *B. japonica* never shows the successive development of rings of wood and bast, which is clearly shown by *B. Championi*. However, it is considered that the former species also is capable of showing this anomaly in axes of far greater thickness than those in the material observed.

As regards plants other than *Bauhinia*, a combined structure of the two types of anomalies is known to occur in *Merremia umbellata* HALL. f., *M. glabra* HALL. f. and *Erycibe paniculata* ROXB., all belonging to the family of Convolvulaceae. In every one of these species, the cleavage of the xylem-mass takes place subsequently to the successive development of rings of wood and bast; and the cleft xylem-mass, due to the process of dilatation alone, is only formed on a small scale; and besides, no secondary bundles are formed in the dilatation-parenchyma.

The cross sections cut from the thickened axes of *Serjania piscatoria* RADLK. (SCHENCK, pl. V, figs. 51-55) make one suspect a combined structure of the above-mentioned anomalies; however, actually, this species never presents the successive development of secondary meristematic rings, and the numerous secondary bundles lying around the primary xylem-mass are those differentiated at random in the phloem part of the primary vascular ring. In this species it is noticed also that small secondary bundles are, as in the case of *B. Championi*, produced in the medullary dilatation-parenchyma, though they remain without showing any notable development.

In conclusion, the classification of anomalous growth within the genus *Bauhinia* is given as follows, *Bauhinia Championi* being proposed as representing a new independent type of anomaly.

1st type: flattening of the xylem-mass, due to locally unequal activity of the cambium ring. Here belong the axes of: *Bauhinia Blumenaviana* SCHENCK (SCHENCK), *Bauhinia* sp. from Brazil (SCHENCK), *Bauhinia japonica* MAXIM. (HANDA), *Bauhinia Championi* BENTH. (HANDA), though for the axes of the last two species this anomaly is not a constant feature.

2nd type: successive development of rings of wood and bast. Here belong the axes of: *Bauhinia rubiginosa* BONG. (SCHENCK), *Bauhinia angulosa* VOG. (SCHENCK, SOLEREDER, PFEIFFER), *Bauhinia VahlII* WIGHT et ARN. (BRANDIS, GAMBLE), *Bauhinia* sp. from Eastindia (SCHENCK).

3rd type: cleavage of the xylem-mass. Here belong the axes of: *Bauhinia Langsdorffiana* BONG. (SCHENCK, RADLKOFER), *Bauhinia* sp. from Brazil (SCHENCK), *Bauhinia* sp.(?) from Brazil (SCHENCK),



*Bauhinia* sp. from Brazil (PFEIFFER); and there belong also the axis and root of *Bauhinia* sp. (WARBURG) and of *Bauhinia japonica* MAXIM. (HANDA), the anomaly of the latter species being regarded as a modification of this type.

4th type: combination of the 2nd and 3rd types. This anomaly is shown in the axes of: a supposed *Bauhinia* species (SCHLEIDEN) and *Bauhinia Championi* BENTH. (HANDA); and also may be shown in the axes of *Bauhinia angulosa* VOG. (SCHENCK).

### Summary

1) Thickened axes of *Bauhinia Championi* present an anomalous structure resulting from two different types of anomalous secondary growth, namely a structure composed of a cleft xylem-mass and one or two successive rings of wood and bast.

2) At a relatively early stage the vascular ring begins to be cleft into several segments by the dilatation occurring in the pith and wood; then in the medullary dilatation-parenchyma there arise a number of secondary bundles. The separate wood-segments soon become provided on their radial sides with a strip of cambium, which is in continuity with the original cambium bordering the outer margin of the segments; so that each segment becomes surrounded by an almost continuous ring of cambium. The cambium activity of the rings thus formed together with that of the secondary bundles gives rise at last to a cleft xylem-mass on a considerable scale. In the longitudinal direction the secondary bundles and the segments become connected by anastomosis.

3) At the time when the anomalous secondary growth relating to the formation of the cleft xylem-mass is regarded as having reached completion, the successive development of rings of wood and bast begins to take place. For a certain reason it is considered that the secondary meristems, which produce the rings of wood and bast, originate in the pericyclic parenchyma.



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### Explanation of plate V

Fig. 1. Cross section of a slender axis, showing a stage in the normal secondary thickening. Distinction of the axial and periaxial woods, furrowed outline of the wood, and cruciform pith may be noticed. ( $\times 4$ )

Fig. 2. Cross section of a slender axis, showing an early stage in the formation of the cleft xylem-mass. The wood is split up into segments, and small secondary bundles (indicated by arrows) are differentiated in the medullary dilatation-parenchyma. ( $\times 4$ )

Fig. 3. More advanced stage than that shown in fig. 2. Medullary dilatation-parenchyma occupies a fairly large area and each wood-segment is almost surrounded by a cambium. ( $\times 3$ )

Fig. 4. Cross section of a thickened axis showing a fully developed cleft xylem-mass. Illustrative reproduction of the complicated outline is given in text-fig. 1. ( $\times \frac{1}{2}$ )

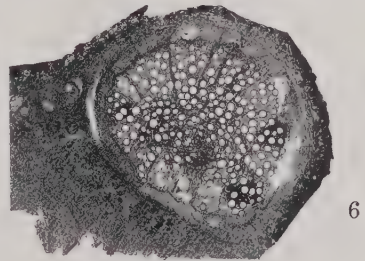
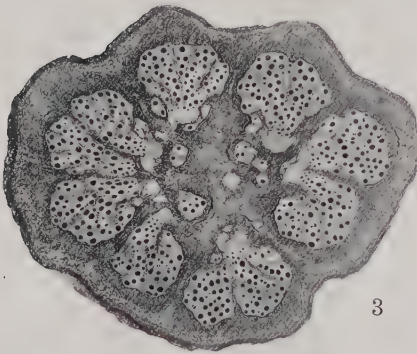
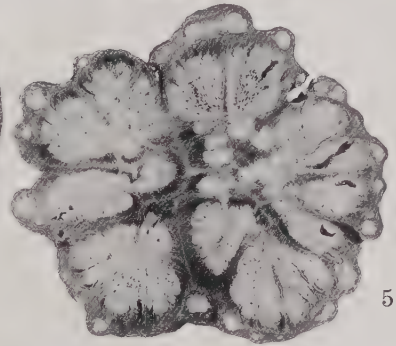
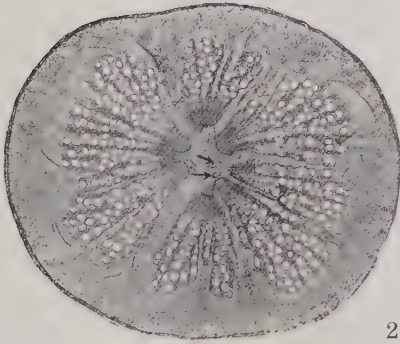
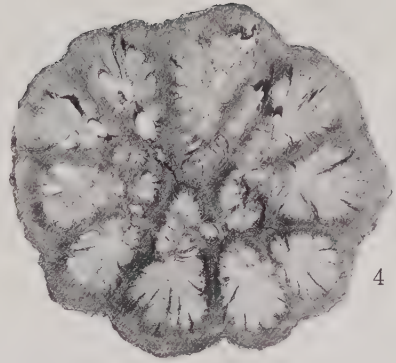
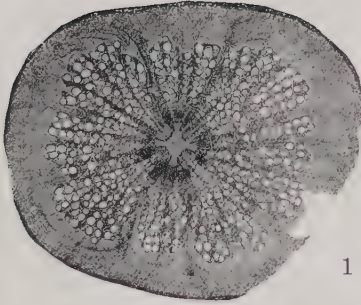
Fig. 5. Cross section of a thickened axis. Marginal bundles belong to the first, secondary ring of wood and bast. Further explanation in the text. ( $\times \frac{1}{2}$ )

Fig. 6. A concentric bundle magnified from fig. 5. Explanation in the text. ( $\times 4$ )

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PLATE V







# Beeinflussung der Spaltöffnungsweite durch plötzliches Wasserabsperren und -zuführen, mit besonderer Berücksichtigung der Spaltöffnungsbewegung zur Regenzeit

Von Masami MONZI

Mit 4 Textfiguren und 12 Tabellen

(Eingegangen am 3. August, 1938)

## I. Einleitung

Durch eine frühere Untersuchung (1938a) über den Einfluss des Regenfalls auf die Stomatabewegung kam ich zum folgenden Schluss: wenn das Blatt frisch und seine Spaltöffnungen weit geöffnet sind, schliessen sich die Stomata von *Fatsia japonica* mit Anfang des Regens zuerst plötzlich, dann öffnen sie sich langsam, aber wenn das Blatt welkt und die Stomata schon eng geschlossen sind, öffnen sich die Stomata entgegengesetzt zum ersten Fall schnell mit Eintritt des Regens, aber es folgt darauf eine neue Schliessbewegung: in beiden Fällen bringt das Aufhören des Regens eine rasche Öffnung der Stomata mit sich. Als Ursache dieser besonderen Stomatabewegungen vermutete ich eine passive Stomatareaktion mit plötzlicher Veränderung des Wasservorrates im Blatt, welche hauptsächlich durch die von der den Regenfall begleitenden Luftfeuchtigkeitsveränderung verursachte Transpirationsab- oder zunahme und den während des Regenfalls noch anhaltenden Wasseranstieg von unten durch den Blattstiel herbeigeführt wird. Ist diese Ansicht stichhaltig, so müssen die gleichen Stomatabewegungen in Erscheinung treten bei einer Wasservorratsveränderung im Blattgewebe, die ohne Regenfall oder Benetzung des Blattes, d.h. ohne Einfluss klimatischer Faktoren, lediglich infolge Wasserabspernung oder -zuführung durch das Schnittende eines in Wasser eingetauchten Blattstiels, anders gesagt, nur durch Veränderung der Intensität der Bodenwasser-Zufuhr verursacht wird.

Um den Mechanismus der eigentümlichen Stomatabewegungen zur Regenzeit zu erklären, habe ich schon in meiner früheren Arbeit die An-

nahme gemacht, dass die Stomatabewegungen nicht nur auf der Wirkung der Schliesszellen, sondern auch in einem gewissen Umfang, wie es schon durch VON MOHL (1856), DARWIN (1904), DARWIN u. PERTZ (1911), LAIDLAW u. KNIGHT (1916), KNIGHT (1917, 1922), STEINBERGER (1922), WEBER (1926, 1927a), STÄLFELT (1929) u.A. bestätigt worden war, auf einer Wirkung der Neben- und Epidermiszellen beruhen. Der Grundgedanke dieser Autoren beruht einerseits auf einer vorübergehenden Stomataerweiterung beim Anfang des Blattwelkens (DARWIN, DARWIN u. PERTZ, LAIDLAW u. KNIGHT, KNIGHT, WEBER), anderseits auf dem Stomataverschluss, der bei Eintauchen einer Blattspreite ins Wasser oder bei Wasserinfiltration derselben stattfindet (VON MOHL, STEINBERGER, WEBER, STÄLFELT). Über den Einfluss der plötzlich von unten durch den Blattstiel wieder einsetzenden Wasserzufuhr auf die durch vorherige Wasserabsperrung hervorgerufene weite Öffnung der Spalten haben wir aber bis jetzt nur wenige Abhandlungen (vgl. SCARTH 1927). Zur Aufklärung dieser Zusammenhänge suchte ich in vorliegender Arbeit einige Anhaltspunkte zu gewinnen, einmal durch unter sonst fast Konstanten Aussenbedingungen angestellte Experimente, im besonderen durch Untersuchung der Frage nach Mitwirkung der Neben- und Epidermiszellen auf die in Rede stehende Erscheinung.

Die vorliegende Untersuchung bestätigt einmal, dass die durch Regulierung der Wasserzufuhr hervorgerufene Stomatabewegung, wie schon von mir zur Regenzeit beobachtet, mit der Wassergehaltsveränderung des Blattes im Zusammenhange steht, und weiter, dass der Wechsel der Transpiration fast analog zu demjenigen der Stomatabewegung vor sich geht.

## II. Methodik und Versuchsmaterial

Wie bei der früheren Arbeit gebrauchte ich auch diesmal als Versuchsmaterial das Lichtblatt von *Fatsia japonica* DECNE. et PLANCH. Das Blatt dieses Strauches entfaltet sich im März oder April, aber am jungen Blatt sind Stomata noch nicht völlig ausgebildet, daher kann man daran keine Stomatabewegung ersehen. Erst Ende Mai beginnt der Stomatawechsel, der ein Anzeichen für die völlige Entwicklung des Blattes ist. Die Lebensdauer des Blattes beträgt ein Jahr oder mehr; Anfang Mai vergilbt die Mehrzahl der überwinterten Blätter, und fällt allmählich ab. Die Stomata der völlig vergilbten Blatteile sind stets, selbst am hohen Mittag, eng geschlossen, aber die Stomata des noch grünen überwinterten Blattes zeigen sogar im Mai normalerweise die wechselnden Bewegungen des Tages. So arbeitete ich im März, April und Mai immer mit einem grünen überwinterten Blatt.

Das Versuchsmaterial bereitete ich in der gleichen Weise wie bei der früheren Untersuchung vor; am Morgen eines wolkenlosen Tages entnahm ich also das Versuchsblatt durch Abschneiden an der Basis seines Stiels, und die Schnittfläche wurde noch einmal unter Wasser erneuert. Das so behandelte Blatt wurde ins Gewächshaus gebracht, und horizontal in diffuses Licht gelegt. Alle Fenster des Gewächshauses oder Versuchszimmers blieben während des Versuches geschlossen, um das Blatt in windstillem Zustand zu halten.

Die plötzliche Wasserabsperrung erzielte ich durch Aufsetzen eines mit Vakuum-Hahnfett erfüllten Glasmützchens auf das abgeschnittene Ende des Blattstiels, die plötzliche Wasserzuführung durch Erneuerung der Schnittfläche unter Wasser. Die erstere Behandlung habe ich etwa 20 oder 30 Minuten nach der Verbringung des Versuchsblattes ins Gewächshaus aufgeführt, die letztere aber etwa 10 oder 20 Minuten nach Verstopfung oder Abdichtung der Schnittfläche des Stiels, wenn die Spaltweite des Blattes maximal oder ähnlich ist, oder auch etwa eine Stunde später, als die bereits weit geöffneten Stomata sich schon wieder beinahe geschlossen hatten. Die Öffnungsweite bestimmte ich gewöhnlich alle 5 oder 10 Minuten.

Zur Bestimmung der Spaltweite habe ich auch hier, wie bei der früheren Arbeit, die Infiltrationsmethode angewendet. Aber diesmal stellte ich mit einer Stoppuhr die Infiltrationszeit fest, d.h. die Zeitspanne, während deren ein Tröpfchen der Infiltrationsflüssigkeit von der Blattoberfläche völlig verschwindet, und berechnete die Spaltweite nach der Quadratwurzel der Infiltrationszeit, die mit Rücksicht auf die vor und nach dem Infiltrationsversuch auf einer matten Glasplatte gemessene Verdunstungszeit eines Tröpfchens der Versuchsflüssigkeit korrigiert wurde. Den hundertfachen Wert der Quadratwurzel der korrigierten Infiltrationszeit möchte ich, an Stelle der „Infiltrationszahl“ in der früheren Arbeit, den „Infiltrationskoeffizienten“ nennen. Nach diesem Koeffizienten vermag man die relative Spaltöffnungsweite quantitativ ziemlich streng zu beurteilen (vgl. MONZI 1938b). Als Infiltrationsflüssigkeit bediente ich mich nur mässig infiltrierbaren Benzols, und als geeigneten Abtröpfungsgefäßes einer Injektionsspritze von 1 cc mit einer Hohnadel, deren Aussen- und Innendurchmesser 0,50 mm bzw. 0,33 mm war. Mit einer solchen Spritze kann man Benzol in einer Menge von  $5,00 \cdot 10^{-3}$  cc (bei 26°C) betröpfeln, wobei die Maximal-Schwankung des Tröpfchenvolumens etwa  $\pm 6\%$  beträgt.

Die Infiltrationszeit habe ich innerhalb 1–2 Minuten nach dem Abschneiden des Blattstückens bestimmt; daher kommt dort kaum eine nennenswerte Beeinflussung durch Zerschneiden vor, wie man aus Tabelle 1 ersieht.

TABELLE 1. Die Öffnungsweite der Stomata vor und nach dem Abschneiden des Blattstückchens. Das Blatt wurde um 8, 10 Uhr abgenommen.

Am 14. April 1938. Klares Wetter

Versuchs- zeit Uhr	Lufttemp. °C	Psy-diff. °C	Infiltrationskoeffizient		
			vor dem Abschneiden	am abgeschnittenen Blattstückchen	nicht abgeschn.: abgeschnit.
8,20	18,0	5,8	9,8	10,5	0,933
9,40	21,0	6,5	18,9	18,4	1,028
10,50	24,7	7,6	24,9	25,0	0,996
12,05	25,0	7,9	27,9	27,3	1,022

TABELLE 2. Die Stomatabewegung des abgeschnittenen *Fatsia*-Lichtblattes bei der Wasserzufuhrveränderung. Um 8,55 Uhr wurden die Versuchsblätter der Mutterpflanze entnommen. Am 16. April 1938. Klares Wetter

Versuch szeit Uhr	Lufttemp. °C	Psy-diff. °C	Infiltrationskoeffizient		
			Blatt I (Kontrolle)	Blatt II	Blatt III
9,10	22,5	6,7	9,8	13,3	8,5
20	22,6	6,6	11,3	16,0	13,2
30	22,6	6,3	12,4	14,7	13,1
„				Absperrung	Absperrung
35	23,0	6,7	10,6	20,8	16,8
40	22,8	6,4	17,8	25,0	18,9
45	23,2	7,0	—	24,8	22,3
„				Wasserzufuhr	
50	23,1	7,1	16,5	17,4	27,8
55	23,3	7,3	—	13,3	29,2
10,00	24,0	7,5	20,3	8,4	26,9
05	24,3	7,6	—	14,1	19,2
10	24,1	7,5	20,9	19,5	18,0
20	24,5	8,2	19,6	20,4	17,3
„					Wasserzufuhr
25	25,0	8,5	—	21,8	23,5
30	25,0	8,4	21,2	—	16,7
35	25,4	8,3	21,4	23,9	11,7
40	24,8	8,1	—	—	15,6
45	25,0	8,0	20,9	24,8	16,2
55	24,4	7,9	23,3	23,9	17,8
11,05	25,0	8,1	22,9	22,4	23,8
15	25,1	8,1	22,8	23,9	25,0

### III. Spaltöffnungsbewegung mit plötzlicher Veränderung der Wasserzufuhr

Unter mehreren diesbezüglichen Versuchen möchte ich zunächst die am 16. April vorgenommene Untersuchung hervorheben, deren Protokoll in Tabelle 2 zusammengestellt und auch in Figur 1 graphisch gezeigt wird.

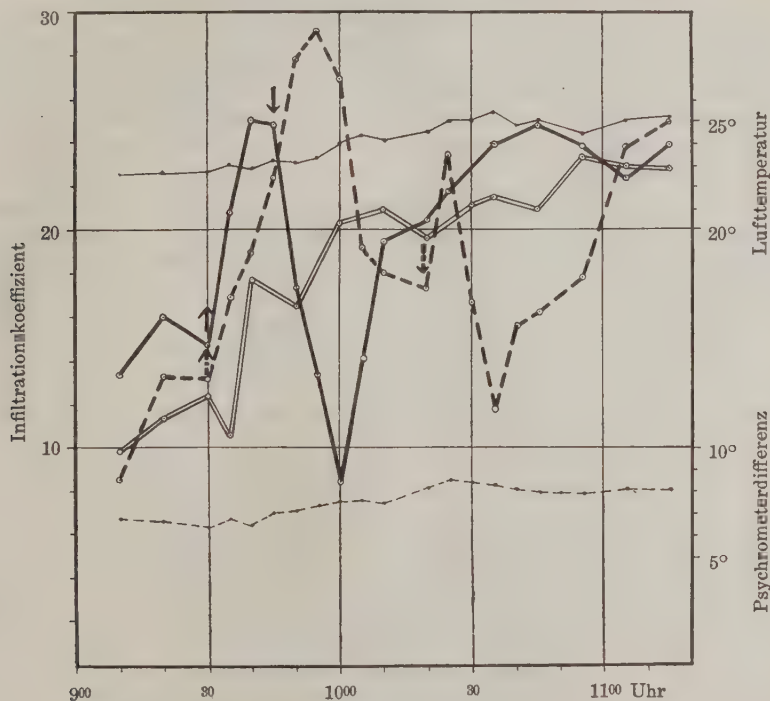


Fig. 1. Die Stomatabewegung des abgeschnittenen *Fatsia*-Lichtblattes bei der Wasserzufuhrveränderung (vgl. Tab. 2).

	Entnahme	Absperrung	Wasserzufuhr
— Blatt I (Kontrolle)	8,55 Uhr	—	—
— Blatt II	" "	9,30 Uhr	9,45 Uhr
- - - Blatt III	" "	9,30 "	10,20 "
		(Aufgerichteter Pfeil)	(Abwärts gerichteter Pfeil)

Die Stomata des Kontrollblattes (Blatt I) zeigen die gewöhnliche Tageskurve. Die des Versuchsblattes II und III öffneten sich bei Absperrung (um 9,30 Uhr) in gleicher Weise sehr rasch; aber mit erneuerter Wasserzufuhr (am Blatt II um 9,45 Uhr, am Blatt III um 10,20 Uhr) schlossen sich am Blatt II plötzlich die weit geöffneten Stomata, während



am Blatt III, dessen Stomata durch lang andauernde Wasserabsperrung schon geschlossen waren, damit eine kurzfristige Öffnung eintritt, später aber öffneten sich die Stomata beider Blätter ebenso weit wie die des Kontrollblattes. Im Folgenden werde ich diese Beobachtungen ausführlich erörtern.

### (1) Die durch plötzliches Wasserabsperrn verursachte Spaltöffnungsbewegung

Mehrere Forscher, namentlich DARWIN (1904), LAIDLAW u. KNIGHT (1916), KNIGHT (1917, 1922), WEBER (1927a), STÄLFELT (1929) beobachteten ein Öffnen der Spaltöffnung beim Anfang des Welkens, dagegen LLOYD (1908, 1913), LINSBAUER (1917), BAKKE (1918) u.A. das Gegenteil. Über dieselbe Erscheinung hat auch MOLISCH (1912) berichtet, ohne aber diese anfängliche Stomataerweiterung zu konstatieren. Durch eigene Versuche konnte ich am *Fatsia*-Lichtblatt fast stets ein Öffnen der stomatären Apertur unmittelbar nach der künstlichen Wasserabsperrung wahrnehmen (vgl. Fig. 1 od. Tab. 2, Blatt II 9,30–9,40 Uhr, Blatt III 9,30–9,55 Uhr; Fig. 2, 10,40–10,55 Uhr; Fig. 3, 9,50–10,15 Uhr).

Unter meinen Versuchsbedingungen erreicht die Spaltweite im allgemeinen, wie aus Tabelle 3 ersichtlich ist, 10 bis 20 Minuten nach Verstopfung der Schnittfläche des Blattstiels das Maximum. Auf diese

TABELLE 3. Das Öffnen und darauf folgendes Schliessen der stomatären Apertur durch die künstliche Absperrung der Wasserbahnen

Versuchsdatum	Lufttemp. °C	Psydiff. °C	Absperr. Uhr	relativer Infiltrationskoeffizient												
				Absperrung	5	10	15	20	25	30	35	40	45	50	Minuten	
17. März	22	6	10,20	100 (24,5)	135	159	161	—	151	—	—	—	—	—		
" "	"	"	10,20	100 (28,7)	133	115	127	126	—	111	—	70	—	70		
18. "	23	7	9,50	100 (15,4)	127	147	—	162	102	—	94	—	—	—		
" "	"	"	9,50	100 (19,0)	116	111	—	128	89	—	—	73	—	—		
19. "	23	8	8,50	100 (15,4)	137	161	171	112	104	101	108	95	103	—		
" "	24	8	10,10	100 (23,7)	106	112	88	51	68	54	—	62	—	—		
26. "	25,5	7	9,10	100 (17,2)	133	178	187	157	185	137	149	124	104	102		
6. Apr.	25	9	10,30	100 (16,9)	—	170	—	115	96	90	—	79	—	68		
14. "	24	7	10,10	100 (11,9)	133	202	—	247	176	151	—	—	—	—		
16. "	23	7	9,30	100 (13,1)	128	144	170	212	223	205	147	137	—	132		
10. Mai	21,5	6,5	9,25	100 (14,0)	—	173	—	171	—	—	—	—	—	—		

maximale Öffnung folgt mit Fortschritt des Wassermangels ein neues Schliessen der Stomata, worüber schon DARWIN, LAIDLAW u. KNIGHT, KNIGHT u.A. sich geäußert haben, und es dauert nach der Verstopfung

etwa eine Stunde lang an (vgl. Fig. 1 od. Tab. 2, Blatt III 9,55–10,20 Uhr; Fig. 3, 10,15–10,40 Uhr und Tab. 3).

## (2) Die durch erneuerte Wasserzufuhr verursachte Spaltöffnungsbewegung

Der Einfluss der abermaligen Wasserzufuhr auf die schon einmal durch Verstopfung beeinflussten Stomata hängt offenbar stark von der Öffnungsweite der Stomata oder von den Wasserverhältnissen des Blattes ab.

### a. Bei weit geöffneter Spaltöffnung

Die unter Wasser ausgeführte Schnittflächenenerneuerung des verstopften Blattstiels bewirkt an den nach Absperrung weit geöffneten Stomata eine rasche Schliessbewegung. Nachdem die Spaltweite sich

TABELLE 4. Der mit der erneuten Wasserzufuhr rasch eintretende Verschluss der geöffneten Stomata eines verstopften Blattes

Versuchsdatum	Lufttemp. °C	Psydiff. °C	Absperr. Uhr	W. Zfr. Uhr	relativer Infiltrationskoeffizient									
					Wasserzufuhr	5	10	15	20	25	30	35	45	50
17. März	21	6	10,20	10,45	100 (36,9)	74	48	44	—	59	—	65	63	—
19. „	23	8	8,50	9,00	100 (30,4)	77	42	31	53	59	71	84	—	—
„ „	24	8	10,10	10,15	100 (26,5)	68	61	41	64	81	—	88	—	—
26. „	26,5	8	9,25	9,40	100 (29,4)	54	58	49	48	56	61	68	81	—
6. Apr.	26	9	11,05	11,15	100 (24,0)	42	51	62	—	—	—	—	—	—
14. „	24	7	10,10	10,25	100 (31,8)	58	44	52	—	—	—	—	—	—
16. „	24,5	8,5	9,30	9,45	100 (24,8)	70	54	34	57	79	—	82	—	96
10. Mai.	22,5	7	9,25	9,55	100 (24,0)	—	25	—	34	—	56	—	—	—

beinahe 15 Minuten nach der Behandlung zum Minimum geschmälert hat, beginnt aufs neue ein langsames Öffnen, was die nächste Tabelle veranschaulicht (vgl. auch Fig. 1, Blatt II 9,45 Uhr).

Um diese Stomatabewegung eingehender zu untersuchen, habe ich Infiltrationen mit Abstand von 1 Minute vorgenommen, dessen Ergebnis in Figur 2 graphisch dargestellt ist.

Meine Resultate bestätigen ohne weiteres die schon durch VON MOHL (1856), DARWIN (1904), DARWIN u. PERTZ (1911), STEINBERGER (1927), WEBER (1927a), STÄLFELT (1929) u.A. entdeckte Tatsache, dass die über-

mässige Zufuhr des Wassers einen Verschluss der geöffneten Spaltöffnung hervorruft.

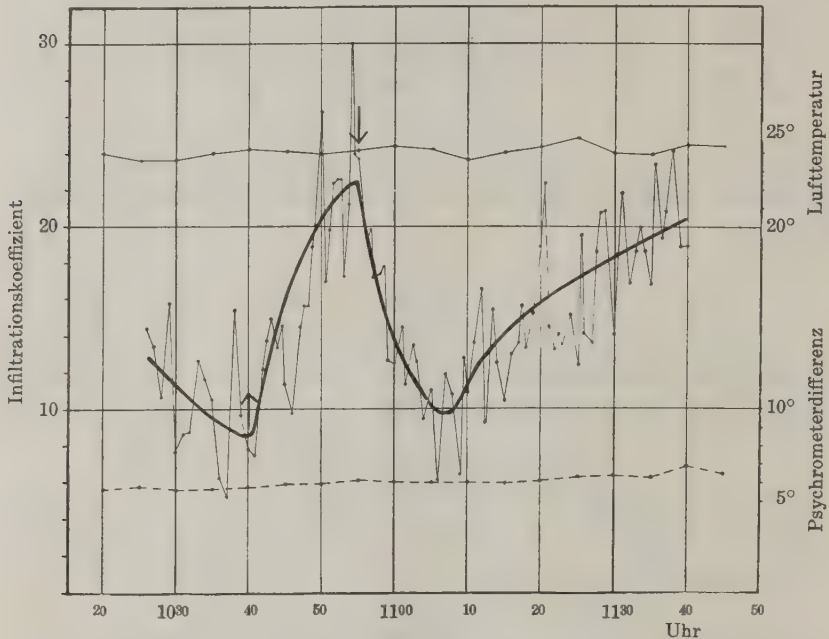


Fig. 2. Die Stomatabewegung eines abgeschnittenen *Fatsia*-Lichtblattes mit der künstlichen Wasserzufuhrregulation. Am 21. April 1938. Klares Wetter. Der Blattstiel wurde um 10,15 Uhr abgeschnitten, um 10,40 Uhr verstopft (aufgerichteter Pfeil), um 10,55 Uhr aufs neue unter Wasser abgeschnitten (abwärts gerichteter Pfeil).

### b. Bei geschlossener Spaltöffnung

Dass die geschlossenen Stomata eines welken Blattes sich mit erneuerter Wasserzufuhr rasch öffnen, wurde nur durch von MOHL (1856), ILJIN (1922, 1933) und KNIGHT (1922) beobachtet. Solches kurzfristiges Öffnen der Stomata konnte ich nach Erneuerung der Schnittfläche auch an den *Fatsia*-Blättern feststellen, bei welchen nach Wasserabspernung das Stadium maximaler Öffnungsweite schon überschritten war. Unter den Versuchsergebnissen, die in Tabelle 5 zusammengestellt sind, kann man vor allem die folgenden hervorheben: das Maximum der Öffnung der Stomata tritt etwa 5 Minuten nach dem neuen Abschneiden des Blattstiels ein, darauf aber folgt eine andere schnelle Schliessbewegung, die bis etwa 15 Minuten nach der Behandlung andauert, und wie bei den weit öff-

neten Stomata (siehe a) beobachtet, fängt danach ein langsames Öffnen der Spalten an.

TABELLE 5. Das mit der erneuerten Wasserzufuhr hervorgerufene kurzfristige Öffnen der eng geschlossenen Stomata des früher verstopften Blattes.

Versuchsdatum	Lufttemp. °C	Psydiff. °C	Abspr. Uhr	W-Zfr. Uhr	relativer Infiltrationskoeffizient									
					Wasserzufuhr	5	10	15	20	25	30	35	45	55
17. März	22	6	10,20	11,40	100 (20,2)	159	96	—	—	109	—	—	—	—
26. „	26,5	8	9,10	10,00	100 (17,6)	151	70	65	—	99	—	106	136	141
1. Apr.	25	8	11,10	11,30	100 (14,5)	127	97	71	—	—	—	—	—	—
6. „	25,5	8,5	10,30	10,50	100 (11,7)	167	118	119	—	—	—	—	—	—
„	26,5	9,5	10,30	11,35	100 (11,6)	144	84	67	—	—	—	—	—	—
16. „	24,5	8	9,30	10,20	100 (17,3)	136	96	68	90	94	—	103	137	144

Auch in diesem Fall versuchte ich die Infiltration minutenweise (Fig. 3), um ein klares Bild in bezug auf diese Stomatabewegung gewinnen zu können.

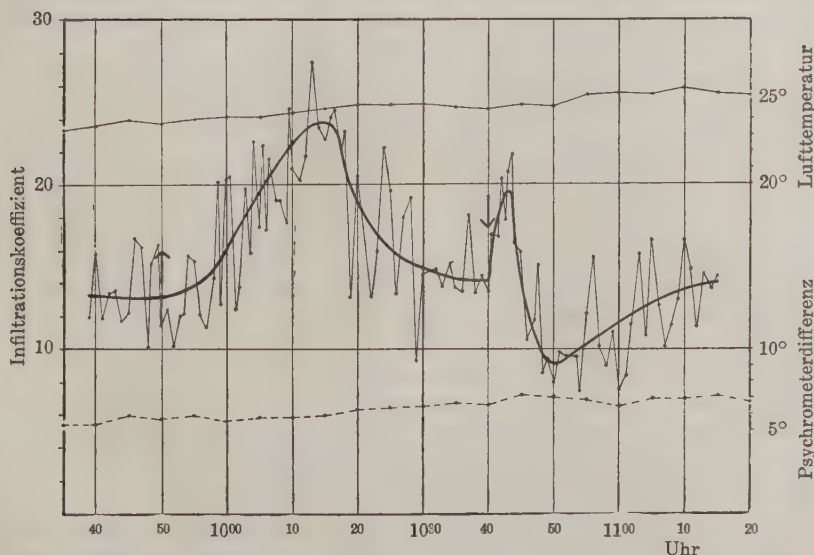


Fig. 3. Die Stomatabewegung eines abgeschnittenen *Fatsia*-Lichtblattes mit der künstlichen Wasserzufuhrregulation. Am 19. April. Klares Wetter. Der Blattstiel wurde um 9,30 Uhr abgeschnitten, um 9,50 Uhr verstopft (aufgerichteter Pfeil), um 10,40 Uhr aufs neue unter Wasser abgeschnitten (abwärts gerichteter Pfeil).

#### IV. Vergleichung der durch Wasserzufuhrregulation verursachten Spaltöffnungsbewegung mit derjenigen zur Regenzeit

Die Beeinflussung der Öffnungsweite der Stomata durch Regenfall untersuchte ich schon in meiner früheren Arbeit (1938 a) mit demselben Versuchsmaterial und künstlichem Regen, und als Hauptursache konstatierte ich die durch Regenfall herbeigeführte Zu- oder Abnahme des Wassergehaltes im Blattgewebe. Daher möchte ich die Prognose stellen, dass eine wesentliche Identität zwischen der durch Wasserzufuhrregulation veranlassten Stomatabewegung und der zur Regenzeit eintretenden tatsächlich besteht, weil beide ursächlich auf dem gleichen Grund, d.h. auf der Wasservorratsveränderung im Blattgewebe beruhen.

Die durch künstliche Absperrung der Wasserbahnen hervorgerufene anfängliche Öffnungsbewegung könnte mit der nach dem Aufhören des Regens vor sich gehenden Beschleunigung des Öffnens verglichen werden, da die beiden Öffnungen der Stomata ursächlich aus der Abnahme des supraoptimalen Wasservorrates entstehen. Den durch Regenfall hervorgerufenen Stomatabewegungen entsprechen der durch die Wasserzufuhrerneuerung verursachte Spaltenverschluss und das darauf folgende langsame Öffnen. Die Tatsache der schnellen Schliessbewegung der Spaltöffnung bei Wasserzufuhrerneuerung gründet auf der im Blatt aufgetretenen, plötzlichen Wasserzunahme, worüber ich später in dieser Abhandlung noch eingehender zurückkommen werde, und die anfängliche stomatare Regulation zur Regenzeit einerseits auf der Hemmung der Transpiration und anderseits auf dem noch anhaltenden Wasseraufstieg. Also beruht der rasche Verschluss der weit geöffneten Stomata sowohl bei der Wasserzufuhrerneuerung, als auch beim Regenanfang, auf der Erhöhung des Wasservorrates. Das durch neuerliche Wasseraufnahme herbeigeführte kurzfristige Öffnen der während vorhergehender Verstopfung eng geschlossenen Stomata ist selbstverständlich mit dem vorübergehenden Spaltenöffnen des welken Blattes beim Eintritt des Regens vergleichbar. In den beiden letzteren Fällen kommt also eine plötzliche Wasservermehrung in dem wasserarmen Blatt.

Wie oben dargelegt, haben die durch Wasserzufuhrveränderung verursachten und die durch Regenfall herbeigeführten Stomatabewegungen ihre gemeinsame Ursache in den Veränderungen des Wasservorrates des Blattes, und sie sind grundsätzlich ein und derselbe Ausdruck des allgemeingültigen Reaktionssystems der Spaltöffnungen, der gelegentlich unter verschiedenen Bedingungen in Erscheinung tritt.:



## V. Ursache und Mechanismus der Spaltöffnungsbewegung im Zusammenhang mit der Wasserzufuhrregulation

Da während der oben beschriebenen Versuche die Aussenbedingungen, d.h. Lufttemperatur und -feuchtigkeit, sowie auch Lichtintensität, beinahe konstant gehalten wurden, so möchte ich die Ursache der eigentümlichen Stomatabewegungen, die im Blatt durch Verstopfung bzw. Erneuerung der Schnittfläche des Blattstiels verursacht wird, und den Mechanismus der Mitwirkung der Neben- und Epidermiszellen aufklären. Die letztgenannte Erscheinung haben schon mehrere Autoren, namentlich VON MOHL (1856), DARWIN (1904), DARWIN u. PERTZ (1911), LAIDLAW u. KNIGHT (1916), KNIGHT (1917, 1922), URSPRUNG u. BLUM (1924), STRUGGER u. WEBER (1926), WEBER (1927a), STÅLFELT (1929) u.A. untersucht.

Nach meiner Meinung lässt sich der Mechanismus der zur Regenzeit beobachteten Spaltenbewegungen mit Hilfe der durch künstliche Wasserzufuhrregulation vor sich gehenden Stomatareaktion erklären, weil die beiden Erscheinungen auf ein und dieselbe Ursache zurückzuführen sind. Die folgenden Versuche, die in Tabelle 6 u. 7 dargestellt sind, möchte ich dazu dienstbar machen.

TABELLE 6. Die Stomatabewegung mit wiederholter Absperrung und Wasserzuführung. Am 26. März 1938. Sehr klares Wetter

Versuchszeit Uhr	Lufttemp. °C	Psy-diff. °C	Infiltrationskoeffizient
8,50	23,7	6,3	17,3
9,10	24,8	6,6	15,7
„			1. Absperrung
15	25,2	6,8	23,5
20	25,3	6,9	28,2
„			2. Wasserzufuhr
25	25,5	6,8	19,5
„			2. Absperrung
30	25,6	7,0	17,1
35	25,7	7,4	23,2
40	26,1	7,4	29,4
„			3. Wasserzufuhr
45	26,3	7,3	16,0
55	26,5	7,2	14,5
10,00	26,5	7,9	14,2
10	26,5	8,1	17,8
25	27,5	7,5	23,7

TABELLE 7. Die Stomatabewegung mit wiederholter Absperrung und Wasserzuführung. Um 10,00 Uhr wurden die Versuchsblätter abgenommen. Am 6. April 1938. Klares Wetter

Versuchszeit Uhr	Lufttemp. °C	Psy-diff. °C	Infiltrationskoeffizient
10,30	25,0	8,5	16,9
"			1. Absperrung
40	24,8	8,1	28,8
55	25,7	8,6	16,3
11,10	25,8	9,3	13,3
35	26,5	9,3	11,6
"			2. Wasserzufuhr
38			16,7
41	26,5	9,3	9,7
45	26,5	9,2	7,8
"			2. Absperrung
50	26,5	9,0	12,7
55	26,6	9,7	21,8
12,00	26,2	9,2	30,2
"			3. Wasserzufuhr
05			9,8
10	26,7	9,3	8,7
"			3. Absperrung
20	26,7	9,3	20,8
25	26,9	9,1	32,7

Die bei neuer Wasserzufuhr sich eng schliessenden Stomata, die ehe-  
dem aber durch Absperrung weit geöffnet waren, beginnen mit der  
wiedermaligen Verstopfung der Schnittfläche des unter Wasser gesteckten  
Blattstiels plötzlich sich zu öffnen. Die gleiche Öffnungsbewegung tritt  
bei derselben Behandlung auch an den Stomata eines wasserarmen  
Blattes auf, die sich nach dem durch Erneuerung der Wasserzufuhr ver-  
ursachten kurzfristigen Öffnen schon wieder eng geschlossen haben.  
Auf Grund dieser Versuche können wir den Schluss ziehen, dass die  
Schliessbewegung nach der voraufgehenden kurzfristigen raschen Öff-  
nung, die an den schon geschlossenen Stomata des lang verstopften Blattes  
durch Wasserzufuhrerneuerung plötzlich hervorgerufen wurde, und ebenso  
auch der rasche Verschluss, der gleich nach dem Wasserzufuhrbeginn an  
den zuvor weit geöffneten Stomata vorkommt, ihre wesensgemeinsame  
Ursache in der im Blatt mit Beseitigung der Absperrung eintretenden  
schnellen Wasservorratzszunahme haben, und ferner dass eine Unter-  
brechung der Wasserversorgung die geschlossenen Stomata des supra-

optimal wasserreichen Blattes, unabhängig von dessen früheren Zuständen, stets zur Öffnung bringt.

Ist die Ursache dieser raschen Stomatabewegung in der durch Verstopfung bzw. Erneuerung des Schnittendes am Blattstiel entstehenden Ab- oder Zunahme des Wasservorrates des Blattes zu suchen, so muss

TABELLE 8. Wassergehaltsveränderung durch Verstopfung und Erneuerung der Schnittfläche des Blattstiels. Am 30. März 1938. Klares Wetter

Versuchszeit Uhr	Lufttemp. °C	Psych.-diff. °C	Wassergehalt in % des Frischgewichtes
10,20	24,8	6,1	60,7
30	24,5	6,1	61,4
„			Verstopfung
40	24,7	6,2	60,2
50	24,5	6,2	59,9
„			Erneuerung d. Schnittfl.
11,00	24,5	6,0	61,1
10	24,6	6,7	61,7

TABELLE 9. Wassergehaltsveränderung durch Verstopfung und Erneuerung der Schnittfläche des Blattstiels. Das Blatt wurde um 9,20 Uhr der Mutterpflanze entnommen. Lufttemperatur im Versuchszimmer ca. 22°C, Psychrometerdifferenz ca. 5°C. Am 29. April 1938

Versuchszeit Uhr	Wassergehalt in % des Frischgewichtes
9,40	62,9
41	Verstopfung
42	62,7
45	62,2
10,10	61,5
11	Erneuerung d. Schnittfl.
12	61,9
15	62,1

erst eine Schwankung des Wassergehaltes in der gleichen kurzen Zeitspanne aufgewiesen werden. Einigen Minuten nach der Behandlungen konnte ich durch die in Tabelle 8 und 9 dargestellten Versuche die Wasservorratsveränderung des Blattgewebes wirklich bestätigen. Auch, dass die Blatt-Turgescenz sogleich nach diesen Behandlungen sich zu verändern anfängt, wurde durch das Ab- oder Aufsteigen eines Gewichtes, das an die Spitze des Blattlappens gehängt wurde, bestätigt.

Die Verstopfung der Schnittfläche mit Vakuum-Hahnfett hat eine Kohäsionsspannung der Wasserbahnen im Gefolge. Das Vorhandensein derselben konnte ich, doch nur mittelbar, nach Bestimmung des Wassergehaltes der Blattspreite und des Blattstiels vermuten. Der Wassergehalt des verstopften Blattstiels ist, wie in Tabelle 10 gezeigt weit grösser als der des aus dem Wasser herausgenommenen Blattstiels, was die Annahme nahe legt, dass der Stillstand des Wasserstroms mit der Zunahme der Kohäsionsspannung parallel geht. Aber nicht durch die Veränderung der

TABELLE 10. Wassergehalt der Blattspreite und des Blattstiels. Die Blätter wurden um 10,20 Uhr der Mutterpflanze entnommen. Lufttemperatur im Versuchszimmer ca. 25,5°C, Psychrometerdifferenz ca. 9°C.  
Am 13. Mai 1938. Sehr klares Wetter

		Blatt I (Kontrolle)	Blatt II	Blatt III
10,55 Uhr		—	die Schnittfl. verstopft	aus d. Wasser herausgenommen
11,55 Uhr				
Blattspreite	Frischgewicht Trockengewicht Wassergehalt	27,52 g 9,23 g 66,5% (100)	30,60 g 10,93 g 64,3% (96,7)	25,71 g 9,37 g 63,6% (95,6)
Blattstiel	Frischgewicht Trockengewicht Wassergehalt	9,20 g 2,07 g 77,5% (100)	10,85 g 2,54 g 76,6% (98,8)	8,48 g 2,13 g 74,9% (96,6)

Kohäsionsspannung selbst, sondern allein durch die Wasservorratsab- oder -zunahme wird die Stomatabewegung bei der Verstopfung bzw. Erneuerung des Schnittendes des Blattstiels herbeigeführt. Um den diesbezüglichen Sachverhalt zu bestätigen, machte ich am 14. April eine Untersuchung über die Stomatabewegung ohne Verstopfung des Blattstiendes: in diesem Fall erzielte ich die Wasserabsperrung durch Halten des Schnittendes des Blattstiels in der Luft und die Wasserzuführung durch Eintauchen des Stielendes ins Wasser, wobei aber die Schnittfläche unter Wasser erneuert wurde, um den Wasseranstieg leichter zu machen. Auf Grund des Ergebnisses dieses Versuches, das in Tabelle 11 zusammengestellt ist, müssen wir anerkennen, dass die Stomatabewegungen denjenigen der Verstopfungsversuche ganz gleich sind, d.h. bei Herausnahme des Blattstiendes vom Wasser kommt eine Öffnung der Stomata vor. Wird aber das Schnittende wieder ins Wasser gebracht, so schliessen sich die beinahe maximal geöffneten Stomata sehr rasch (Blatt I), wohingegen sich die bei 50 Minuten dauerndem Auslassen aus dem Wasser eng geschlossenen Stomata bei Wiedereinbringen kurzfristig öffnen (Blatt II), und

auf das danach kommende Spaltenminimum folgt noch einmal eine langsame Öffnungsbewegung der Stomata der beiden Blätter.

TABELLE 11. Stomatabewegung mit Herausnahme und Eintauchen des Stielendes aus oder ins Wasser. Am 14. April 1938. Klares Wetter

Versuchszeit Uhr	Lufttemp. °C	Psych.-diff. °C	Infiltrationskoeffizient	
			Blatt I	Blatt II
8,35	17,1	5,0	10,3	8,0
55	20,0	5,8	16,8	14,0
„			Herausnahme	Herausnahme
9,00	20,0	5,8	18,7	20,1
05	20,0	5,7	20,2	22,7
10	19,9	5,3	22,9	23,8
„			Eintauchen	
15	20,0	5,3	13,7	23,5
20	20,1	5,6	13,1	16,0
30	20,9	6,2	15,0	15,8
45	21,5	6,5	18,0	12,8
„				Eintauchen
50	22,0	6,6	—	19,0
55	21,6	7,0	18,8	10,0
10,00	21,6	7,1	—	8,1
10	22,5	7,0	20,1	11,9

Dass die Stärkekörner in den Schliesszellen mit Öffnen der Stomata verschwinden und mit Schliessen wieder hervorkommen, ist von ILJIN (1915, 1922, 1933), STEINBERGER (1922) sowie STRUGGER u. WEBER (1925) gefunden worden. Aber bei den durch Wasserzufuhrveränderung verursachten, schnellen Stomatabewegungen des *Fatsia*-Blattes zeitigten meine wiederholten Untersuchungen stets nur die entgegengesetzten Ergebnisse. Ich bestimmte mit der Hälfte eines frisch abgeschnittenen Blattstückens die Infiltrationszeit, und mit der anderen mikroskopisch den Stärkegehalt der Schliesszellen der Epidermisflocke, die, um Veränderungen des Plasmazustandes und Stärkegehaltes nach der Abschälung möglichst zu vermeiden, mit einem durch Jodjodkalilösung benetzten Rasiermesser abgeschält wurde. Der Versuchstag, 10. Mai war klar. Die Lufttemperatur im Versuchszimmer betrug 23°C, und die Psychrometerdifferenz 7,5°C. Die noch nicht geöffneten Stomata, deren Infiltrationskoeffizient 14,0 war, öffneten sich innerhalb 10 Minuten nach der um 9.25 Uhr erfolgten Verstopfung und hatten dann den Infiltrationskoeffizient 24,2. 10 Minuten später erneuerte ich die Schnittfläche; die geöffneten



Stomata schlossen sich nun sehr rasch (Infiltrationskoeffizient nach 10 Minuten 6,0). Um 10,15 Uhr wiederholte ich die Verstopfung, dabei nahm der Infiltrationskoeffizient von 13,5 in den ersten und weiteren 10 Minuten bis 27,9 und 30,4 zu, darauf kam eine neue Schliessbewegung mit Wassermangel (Infiltrationskoeffizient 10,1). Trotz dieser bedeutenden Stomatabewegungen konnte ich die ganze Versuchszeit hindurch in den Schliesszellen dieses Blattes keine Mengenveränderung der Stärkekörner wahrnehmen. Am folgenden Tag wiederholte ich denselben Versuch; dabei kam beispielweise innerhalb 15 Minuten nach Verstopfung eine 110 prozentige Zunahme des Infiltrationskoeffizienten vor, aber auch diesmal wurde kein das Öffnen der Spalten begleitender Stärkeschwund beobachtet. Am 2. Juni stellte ich weitere Versuche über diese Frage mit einem jungen *Fatsia*-Blatt an, und kam zum gleichen Ergebnis. Eine durch Wasserabsperren und -zuführen hervorgerufene rasche Stomatareaktion beträchtlichen Umfangs scheint mir, ohne jedoch von Stärkeab- und -aufbau in den Schliesszellen begleitet zu sein, lediglich infolge von Ab- oder Zunahme des Wasservorrates im Blattgewebe aufzutreten zu vermögen.

Auf Grund der oben erwähnten Versuche können wir nun schliessen, dass die Stomatabewegungen, die durch Verstopfung und Erneuerung des Schnittendes des im Wasser stehenden Blattstiels hervorgerufen werden, ihre Ursache in den plötzlich durch die Behandlung herbeigeführten Veränderungen des Wasservorrates im Blattgewebe haben, und dass der dabei vorkommende Reaktionsmechanismus der Stomata mit dem zur Regenzeit beobachteten identisch ist, wobei eine Mitwirkung der Neben- und Epidermiszellen auf die Hauptwirkung der Schliesszellen zu beachten ist.

## VI. Transpirationsverlauf und Wasserzufuhrregulation

Am 30. April (klares Wetter) untersuchte ich die Transpiration eines abgeschnittenen *Fatsia*-Blattes durch Wägung. In diesem Fall habe ich die Spaltweite unberücksichtigt gelassen. Um 8,30 Uhr morgens schnitt ich drei möglichst gleich gestaltete Lichtblätter von einer im Freien wachsenden Pflanze ab, und brachte sie mit Wasser versehen ins Gewächshaus. Das Blatt I, dessen Blattspreite im Frischgewicht 27,5 g, und in der Fläche 485 qcm betrug, diente mir ohne Wasserzufuhrveränderung als Kontrollblatt. Das Blatt II mit Frischgewicht von 23,8 g und einer Fläche von 455 qcm wurde um 9,33 Uhr an seinem Schnittende mit Vakuum-Hahnfett verstopft, und aufs neue um 9,46 Uhr unter Wasser abgeschnitten. Der Blattstiel von Blatt III wurde um 9,21 Uhr verstopft, und um 10,06 Uhr neu abgeschnitten. Die Blattspreite war im frischen Zustande 23,5 g schwer, und 450 qcm gross. Das Versuchsergebnis ist in Tabelle 12 und in Fig. 4 graphisch zusammengestellt.

TABELLE 12. Der Transpirationsverlauf des abgeschnittenen *Fatsia*-Lichtblattes bei der Wasserzufuhrveränderung. Am 30. April 1938. Klares Wetter

Blatt I (Kontrolle)		Blatt II		Blatt III		Uhr	Luft-temp. °C	Psy-diff. °C
Uhr	Transp. g pro Min. u. 20g Fr-Gw	Uhr	Transp. g pro Min. u. 20g Fr-Gw	Uhr	Transp. g pro Min. u. 20g Fr-Gw			
8,46-52	0,0194	8,44-51	0,0146	8,48-55	0,0134	8,40	21,1	5,9
52-58	0,0207	51-57	0,0239	55-00	0,0307	50	21,0	5,9
58-06	0,0318	57-04	0,0288	9,00-07	0,0256	9,00	21,2	6,2
9,06-10	0,0328	9,04-09	0,0387	07-16	0,0341	10	21,5	6,1
10-18	0,0318	09-17	0,0336	16-20	0,0362			
18-28	0,0364	17-25	0,0368	9,21	Absperr.	25	21,8	6,4
				23-26	0,0426			
28-38	0,0422	25-32	0,0313	26-29	0,0398	30	22,0	6,5
		9,33	Absperr.	29-35	0,0554			
38-44	0,0461	34-37	0,0393	35-39	0,0298	40	21,8	6,5
		37-42	0,0504					
		42-46	0,0440					
44-53	0,0299	9,46	W-Zufuhr	39-50	0,0178	50	23,0	6,6
		48-52	0,0357					
53-58	0,0320	52-56	0,0273	50-54	0,0170			
58-03	0,0262	56-00	0,0189	54-01	0,0110	10,00	23,4	6,6
		10,00-05	0,0168	10,01-06	0,0068			
				10,06	W-Zufuhr			
10,03-13	0,0255	05-10	0,0168	08-12	0,0170	10	24,2	7,0
		10-17	0,0300	12-15	0,0284			
				15-19	0,0362			
13-21	0,0236	17-24	0,0348	19-22	0,0284	20	23,6	6,6
21-28	0,0187			22-26	0,0277			
		24-30	0,0308	26-32	0,0156	30	23,6	6,7
		30-37	0,0360	35-39	0,0192			
38-43	0,0116			39-45	0,0096	40	24,9	7,1
43-48	0,0204	42-46	0,0546	45-49	0,0128			
48-55	0,0167	46-51	0,0404	49-52	0,0170	50	24,6	7,1
		51-57	0,0308	52-58	0,0213			
55-03	0,0182	57-04	0,0372	58-06	0,0309	11,00	25,8	7,4
11,03-15	0,0212	11,04-11	0,0360	11,06-13	0,0401	10	26,0	7,5
		11-16	0,0286	13-17	0,0404			
15-28	0,0140	16-25	0,0271	17-26	0,0398	20	26,1	7,6
		25-30	0,0252	26-31	0,0443	31	26,4	7,4

Aus den oben angegebenen Resultaten können wir einen der Stomata-bewegung ähnlichen Transpirationsverlauf ersehen. Die Transpiration des Kontrollblattes (Blatt I) zeigte eine einfache Tageskurve. Die Transpiration des Blattes II und III nimmt mit Verstopfung des Schnittendes des Blattstiels ziemlich zu. Von einer Zunahme der Transpiration hat

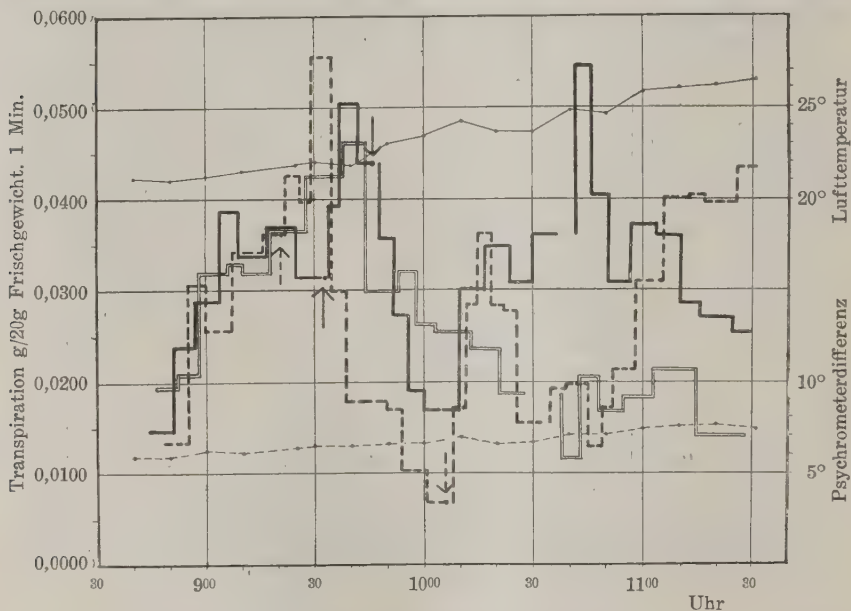


Fig. 4. Der Transpirationsverlauf des abgeschnittenen *Fatsia*-Lichtblattes bei der Wasserzufuhrveränderung. Am 30. April 1938. Klares Wetter. (Vgl. Tab. 12).

	Frischgewicht	Fläche	Entnahme	Absperrung	Wasserzufuhr
— Blatt I	27,5 g	485 qcm	8,30 Uhr	—	—
— Blatt II	23,8 g	455 qcm	„ „	9,33 Uhr	9,46 Uhr
- - - Blatt III	23,5 g	450 qcm	„ „	9,21 Uhr	10,06 Uhr
				(Aufgerichteter Pfeil)	(Abwärts gerichteter Pfeil)

auch HAINES (1936) berichtet, falls die Pflanze unter einem kleinen Druckdefizit ("small pressure deficit") steht. DARWIN (1904), LLOYD (1913)<sup>(1)</sup>, KNIGHT (1917, 1922) und IWANOFF (1928) haben aber desgleichen am abgeschnittenen Blatt oder beim Anfang des Welkens bestätigt, dagegen verneinten BAKKE (1918) und PFLEIDERER (1933)<sup>(2)</sup> die

(1) Er konnte beim Welken des Blattes von *Gossypium* kein vorläufiges Öffnen der Stomata, aber etwa eine halbe Stunde nach dem Beginn des Welkens eine schwache Erhöhung der Transpiration feststellen.

(2) Transpirationszunahme der abgeschnittenen Sprosse kam nach PFLEIDERER nicht im allgemeinen, sondern nur sehr selten vor.

einmalige Transpirationszunahme. Mit dem neuen Wasserzufuhrbeginn um 9,46 Uhr nahm aber die Transpiration des Blattes II sehr rasch (vgl. HAINES 1936), und die des Blattes III, dem Sinken des Wasservorrates entsprechend, in gleicher Weise ab. Über die letztere Erscheinung haben wir schon manche Abhandlungen, aus denen die von STÅLFELT (1931), PFLEIDERER (1933), und FUKUDA (1935) hervorzuheben sind. Die verminderte Transpiration des Blattes II nahm später mit der Zeit allmählich zu, und sie ergab eine Maximalkurve. Beim Blatt III brachte die erneute Wasserzufuhr um 10,06 Uhr eine kurzfristige Zunahme der Transpiration; danach folgte eine Abnahme, aber später begann die Transpiration selbständig noch einmal zu steigen.

Es ist uns eine allbekannte Tatsache, dass die Stomataweite die Transpiration dann streng beherrschen kann, wenn die Spaltöffnungen eng geschlossen und die Mesophyllzellen völlig turgeszent sind (LOFTFIELD 1921, SCARTH 1927, STÅLFELT 1932). Aber andererseits ist auch eine Regulation der Transpiration durch Zugspannung (IWANOFF 1928, MAXIMOV 1929) und Wassergehalt (LLOYD 1908, 1913, LIVINGSTON u. BROWN 1912, KNIGHT 1917, 1922, BAKKE 1918, KERL 1930) oder Wasserdefizit (FUKUDA 1935) festgestellt worden. Wenn wir die Transpirationskurve (Fig. 4) mit der früher erwähnten Stomatareaktion, z.B. Stomatakurve in Fig. 1, vergleichen, so finden wir eine gute Übereinstimmung beider, aber bei genauem Vergleich zeigen die beiden Kurven sowohl in quantitativer, als auch zeitlicher Hinsicht auffällige Verschiedenheiten. Die wichtigsten sind: (1) Die Transpiration des Kontrollblattes begann schon 50 Minuten nach dem Versuchsbeginn trotz ständiger Wasserzufuhr nachzulassen, dagegen waren die Stomata des Kontrollblattes noch am Ende des Versuchs maximal geöffnet. (2) Der Transpirationswert des welken Blattes III war geringer als der des Blattes II, der sich fast parallel dem der neuen Wasserzuführung folgender Stomataverschluss verminderte, aber die Spaltweite des Blattes II erreicht mit erneuter Wasserzufuhr ein schnelleres und tieferes Minimum als das Blatt III. (3) Die durch Wasserzufuhrerneuerung verursachte kurzfristige Zunahme der Transpiration des welken Blattes III stellte sich nur allmählich ein und hielt länger an als die des Spaltenöffnens; die auf die vorübergehende Zunahme folgende Minimal-Transpiration war grösser als der in welchem Zustand vor der Zunahme erreichte Wert: im gerade umgekehrten Verhältnis hiezu steht die Öffnungsweite der Stomata vor und nach dem kurzfristigen Öffnen. Den Widerspruch zwischen beidem kann man aber aufklären, wenn man die Einflüsse der mit den Behandlungen herbeigeführten Zugspannungs- und Wassergehalts- oder Wasserdefizitsveränderungen auf die Transpiration in Rechnung setzt. Freilich sind noch weitere Untersuchungen erforderlich, um das Verhältnis der Transpiration zur Öffnungsweite der Stomata und zu den inneren Transpirationswiderständen durchsichtiger



zu machen als es bis jetzt ist, aber aus den oben beschriebenen Versuchsergebnissen darf ich einwandfrei den Schluss ziehen, dass die Transpiration bei der Wasserzufuhrveränderung hauptsächlich durch die die Behandlung begleitenden, eigentümlichen Stomatabewegungen beherrscht wird, ohne aber eine Beeinflussung der Transpiration durch die Zugspannung der Wasserbahnen und den Wassergehalt bzw. das Wasserdefizit der Pflanzen gänzlich auszuschliessen.

## VII. Zusammenfassung

1. Die vorliegende Arbeit beabsichtigt, die Ursache und den Mechanismus der Stomatareaktion zur Regenzeit zu analysieren, und die Mitwirkung der Neben- und Epidermiszellen auf die Spaltöffnungsbewegung zu erweisen, indem ich die Wasserleitung eines abgeschnittenen und im Wasser stehenden Blattes künstlich reguliere.

2. Als Versuchsmaterial diente mir das überwinterte Lichtblatt von *Fatsia japonica*, und als Bestimmungsmethode der Öffnungsweite der Stomata die Infiltrationsmethode, die von mir früher theoretisch eingeführt wurde. Die Wasserabspernung erzielte ich durch Verstopfung des Schnittendes des Blattstiels mit Vakuum-Hahnfett und die erneuerte Wasserzuführung durch Abschneiden des Stiels unter Wasser.

3. Durch Verstopfung des Blattstielendes erfolgt eine rasche Öffnung der Stomata, dann aber beginnt später in denselben Stomata eine Schliessbewegung. Beginnt die Wasserzufuhr, wenn die Stomata maximal oder ähnlich geöffnet sind, so tritt ein schnelles Schliessen der Apertur auf; aber, wenn die Stomata infolge lang dauernder Absperrung eng geschlossen sind, so zeigt sich eine kurzfristige Öffnung, darauf folgt ein neuer rascher Spaltenverschluss. Nach Eintritt der minimalen Spaltweite folgt bei Fortsetzung der Wasserzufuhr in beiden Fällen eine allmähliche Erweiterung der Spalten.

4. Das durch künstliche Absperrung der Wasserzufuhr herbeigeführte Öffnen der Spalten ist mit der Beschleunigung der Öffnungsbewegung nach dem Aufhören des Regens vergleichbar. Das mit erneuerter Wasserzufuhr plötzlich vor sich gehende Schliessen der Spalten ist zu dem am Anfang des Regens auftretenden Spaltenverschluss analog. Die kurzfristige Öffnung der ziemlich verkleinerten Spaltweite des lang verstopften Blattes, die beim Anfang der neuen Wasserzufuhr fast stets wahrnehmbar ist, entspricht der mit dem Eintritt des Regens vorkommenden Stomataerweiterung des welken Blattes.

5. Die Stomatabewegungen bei der Verstopfung und Erneuerung der Schnittfläche des Blattstiels haben ihre Ursache in der Wasservor-



ratsveränderung im Blattgewebe, aber fast oder gar nicht in der durch die Behandlungen herbeigeführten Zu- oder Abnahme der Kohäsionsspannung innerhalb der Wasserbahnen, und sie lassen sich daraus erklären, dass die Neben- und Epidermiszellen die Schliesszellen gemäss ihrem Turgorzustand seitlich drücken oder ziehen, anders gesagt daraus, dass die Spaltöffnungen in einem gewissen Fall passiv durch Neben- und Epidermiszellen reguliert werden können.

6. Bei der Wasserzufuhrveränderung verläuft die Transpiration des Versuchsblattes fast völlig wie die Stomatabewegung: mit Absperrung nimmt die Transpiration zu; mit erneuerter Wasserzufuhr nimmt die erhöhte Transpiration plötzlich ab; in entgegengesetzter Weise aber nimmt die sinkende Transpiration des bei lang dauernder Absperrung welken- den Blattes einmal rasch zu. Aber neben der Hauptregulation der Spaltöffnungen können auch der Wassergehalt im Blattgewebe und die Kohäsionsspannung in den Wasserbahnen mehr oder weniger die Transpiration regulierende Faktoren darstellen.

Zum Schluss möchte ich Herrn Prof. Dr. H. NAKANO für seine wertvollen Ratschläge und Leitung meiner Arbeit den herzlichsten Dank aussprechen.

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# Progenies of some intergeneric hybrids among *Aegilops*, *Triticum* and *Aegilotriticum*<sup>(1)</sup>

By Yoshiwo KATAYAMA

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With 5 text-figures and 8 tables

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(Received August 4, 1938)

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## Introduction

There are many reports on the constant hybrids derived from crossing two genomatically different species. Such hybrids are amphidiploids formed by the addition of both parent genoms, and as a natural consequence our attention is directed to new constant types of other kinds. Such non-amphidiploids have been reported in wheat-rye hybrids by investigators including FLORELL (1931), LEBEDEF (1932) and KATTERMANN (1937a-c). The writer has been interested in this problem, investigating the progeny of certain intergeneric hybrids among *Aegilops*, *Triticum* and *Aegilotriticum*.

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(1) This work was aided by a grant from the Imperial Academy, to which the writer here records his grateful thanks.

## Material and methods

The species used in this study were

Species	Genom formula
<i>Aegilops ventricosa</i> L.	CCFF
<i>Triticum durum</i> DESF.	AABB
<i>T. vulgare</i> HOST	AABBDD
<i>Aegilotriticum forma fertilis</i> No. 3 KIHARA et KATAYAMA	AABBCCEE

The combination of crossings was *T. durum*  $\times$  *Ae. ventricosa* and its back-cross (BF) by *ventricosa*, and *Aegilotr.* No. 3  $\times$  *T. vulgare* and its back-cross by *vulgare*. The study in progenies was made on  $F_1$ — $F_6$  and  $BF_1$ — $BF_5$  generations.

The materials above indicated were cultivated every year from 1930 to 1936, with the exception of 1933, when prevented by unavoidable reasons, no cultivation was done. Since no seeds were produced from selfed heads of  $F_1$ , as will be referred to later, grains from open heads were sown. In many other cases, seeds for pedigree culture were obtained from individuals which usually showed fair fertility, and from selfed heads with some exceptions. In wheat it is also known that the seeds from well fertile heads usually result from self pollination, if left open.

The fertilities were investigated mostly on open heads to avoid the unfavorable effects of the paraffin paper bag on seed production. The first and second florets were also used.

The cytological observations in this study were made mostly on PMC of fixed material, using CARNOY's and FLEMMING's solution. The smear method, using BELLING's iron-acetocarmine, was sometimes resorted to. The magnification of the figures from permanent preparations is 2000 diameters and that from smeared ones 1500. The photograph of the spikes is reduced approximately to  $\frac{1}{2}$  natural size.

## Chromosome number in subsequent generations

### (1) *TRITICUM DURUM* $\times$ *AEGILOPS VENTRICOSA*

In the  $F_1$  of this cross, 28 chromosomes appeared, mostly as univalents in the meiosis, but some of them conjugated loosely at times, the maximum number of bipartites being usually three (rarely four), as shown in

Fig. 1 a-b. The writer (KATAYAMA, 1931) has reported already on the variation in the number of bipartites due to environmental conditions.

Since these  $F_1$  had never produced seeds in selfed heads enclosed in paraffin paper bags, a few seeds were obtained from open heads, some of which germinated and grew. Back-crosses also gave some plants. The seed production from these will be referred to later.



Fig. 1. First division in PMC of hybrids. a-b,  $F_1$  *T. durum*  $\times$  *Ae. ventricosa*. a, 28<sub>I</sub>. b, 3<sub>II</sub> + 22<sub>I</sub>. c, back-cross  $F_1$  ( $BF_1$ ) (*durum*  $\times$  *ventricosa*)  $\times$  *ventricosa*, 14<sub>II</sub> + 14<sub>I</sub>. d,  $F_1$  *Aegilotr.* No. 3  $\times$  *T. vulgare*, 13<sub>II</sub> + 23<sub>I</sub>.

*Simple hybrid:* The chromosome condition in the progeny from *T. durum*  $\times$  *Ae. ventricosa* is shown in Table 1.



TABLE 1. Chromosome conditions in descendants of *T. durum* × *Ae. ventricosa*

F <sub>1</sub>	F <sub>2</sub>	F <sub>3</sub>	F <sub>4</sub>	F <sub>5</sub>	F <sub>6</sub>
	—46(18 <sub>II</sub> )				
	—47(20 <sub>II</sub> )	—43(21 <sub>II</sub> )	X***	—42(19 <sub>II</sub> )	—42(20 <sub>II</sub> )
	—41(14 <sub>II</sub> )	—52(23 <sub>II</sub> )	—43(20 <sub>II</sub> )	—42(20 <sub>II</sub> )	
28(4 <sub>II</sub> )*	—44(17 <sub>II</sub> )		—42(20 <sub>II</sub> )		
	—46(18 <sub>II</sub> )				
	—45(18 <sub>II</sub> )**				
	—43(16 <sub>II</sub> )**				

\* The numerals within parentheses show the maximum number of bipartites in the observed figures.

\*\* Reciprocal hybrid.

\*\*\* Undetermined.

F<sub>2</sub> plants were obtained from open heads of F<sub>1</sub> plants. As will be seen from the result of the back-cross (see p. 340), the majority of the functional eggs of F<sub>1</sub> plants seem to be in unreduced condition, while occasionally some chromosomes in a genom of these eggs are lacking. The F<sub>1</sub> gamete will therefore be assumed to have from 21 to 28 chromosomes, on which basis the F<sub>2</sub> plant will be regarded as having the following three cases as their origins.

Egg	Pollen	Range of F <sub>2</sub>
21—28	21 (Dinkel)	42—49
„	14 (Emmer)	35—42
„	21—28 (F <sub>1</sub> )	42—56

Although it is not easy to say positively whether or not a certain case belongs to these F<sub>2</sub> individuals that have resulted, it is natural to conclude that the open F<sub>1</sub> flower will be fertilized usually by 14- or 21-chromosome pollen if the F<sub>1</sub> plant was cultivated in the same field with Emmer and Dinkel wheats. By the excess or defect in the number of chromosomes over or under 42, it is possible to say whether the F<sub>1</sub> egg was fertilized by 14 (Emmer)- or by 21 (Dinkel)-pollen. From this reasoning, it may be seen that the F<sub>2</sub> must have originated mostly from fertilization with 21 pollen, and the F<sub>1</sub> eggs were from 22- to 27-chromosomic. The number or condition of conjugated chromosomes in the F<sub>2</sub> meiosis seems to be satisfied as in the case of ABCF × ABD.

The F<sub>2</sub> individual with 47 chromosomes having shown a fairly high fertility, its pedigree culture was obtained (Fig. 5a). In F<sub>3</sub> and F<sub>4</sub> a different number of chromosomes was counted in some observed indivi-

duals, but in  $F_2$  and  $F_3$  the pedigree was balanced nearly in 42 chromosomes (Fig. 4a), although it showed slight anomalies in the meiosis (univalent, etc.) and was accompanied by some individuals showing different characters, whence it is considered that the pedigree is not yet truly



Fig. 2. Spikes from  $F_1$  *T. durum*  $\times$  *Ae. ventricosa* and its hybrid backcrossed by *Ae. ventricosa*. a, *T. durum*. b,  $F_1$ . c-e,  $BF_1$ . f, *Ae. ventricosa*.

constant, owing perhaps to its having semi- or non-homologous chromosomes in some homologous genomes.

*Back-cross hybrid:* The chromosome condition in descendants (Fig. 2) of back-crossings with *ventricosa* is shown in Table 2.

TABLE 2. Chromosome conditions in descendants of  
(*T. durum* × *Ae. ventricosa*) × *Ae. ventricosa*

BF <sub>1</sub>	BF <sub>2</sub>	BF <sub>3</sub>
	40(16 <sub>II</sub> )	38(17 <sub>II</sub> )
42(12 <sub>II</sub> )	36(14 <sub>II</sub> )	40(19 <sub>II</sub> )
42(14 <sub>II</sub> )	37(14 <sub>II</sub> )	38(11 <sub>II</sub> )
36(12 <sub>II</sub> )	34(13 <sub>II</sub> )	39(18 <sub>II</sub> )
	32(15 <sub>II</sub> )	
	29(12 <sub>II</sub> )	

From this result, the chromosome number in the fertilized eggs of F<sub>1</sub> plants is as follows:

2n	Pollen	Egg
42	14	28
42	14	28
36	14	22

Two individuals of three BF<sub>1</sub> had 42 chromosomes, having been derived from unreduced F<sub>1</sub> eggs containing 28 chromosomes, and the maximum number of bivalents was usually from 12 to 14 (Fig. 1c). Since an individual with 36 chromosomes showed 12 bivalents, and produced seeds fairly well, the chromosomal content is assumed to be *ventricosa* genomes (CCFF) and 8 *durum* chromosomes consisting of A + (B-6) or (A-6) + B, because the fewer the incomplete genomes, the more likely to survive.

Although in the progeny of ABC(CFF) we expect various individuals of from CCFF to AABBC(CFF), namely, from 28 to 56 chromosomes, intermediate numbers are usually seen in BF<sub>2</sub> and BF<sub>3</sub>.

## (2). *AEGILOTRICUM* NO. 3 × *TRITICUM VULGARE*

Whereas in the previous cross, the two related species differ completely genomically from each other, in this case the species have some homologous genomes, namely, AABBCCEE and AABBDD.

*Simple hybrid*: The F<sub>1</sub> plant usually showed 14<sub>II</sub> and 21<sub>I</sub>, or nearly similar feature at meiosis (Fig. 1d). A similar result was reported by KIHARA (1931) in the hybrid of other *Aegilotriticum* with *T. spelta*. The chromosome condition in the progeny is shown in Table 3.

TABLE 3. Chromosome conditions in descendants of *Aegilotr.* No. 3  $\times$  *T. vulgare*

F <sub>1</sub>	F <sub>2</sub>	F <sub>3</sub>	F <sub>4</sub>	F <sub>5</sub>	F <sub>6</sub>
	—45(17 <sub>II</sub> )—	34(15 <sub>II</sub> )	—41(20 <sub>II</sub> )—	42(19 <sub>II</sub> )—	41(20 <sub>II</sub> )
49(14 <sub>II</sub> )—	—36(16 <sub>II</sub> )		—43(21 <sub>II</sub> )		—42(20 <sub>II</sub> )
	—43(17 <sub>II</sub> )—	40(18 <sub>II</sub> )	—38(18 <sub>II</sub> )		



Fig. 3. Spikes from F<sub>1</sub> *Aegilotr.* No. 3  $\times$  *T. vulgare* and its hybrid back-crossed by *T. vulgare*. a, *Aegilotr.* No. 3. b, F<sub>1</sub>. c-e, BF<sub>1</sub>. f, *T. vulgare*.

Judging from the results of  $BF_1$  (see below) and these  $F_2$ , the fertilized egg of the  $F_1$  is assumed to have usually from 21 to 28 chromosomes, and that these eggs were fertilized by pollen with either 21 or 14 chromosomes. That is, the genomic constituent of  $F_1$  is AABBCDE, whose eggs containing genomes AB and the major part of a genom from CDE, together with some chromosomes in another genom from CDE, would usually have been fertilized by 21 chromosome pollen, excepting the case of 36 chromosomes. At any rate the above mentioned  $F_1$  egg differs from that in the case of  $F_1$  of *durum*  $\times$  *ventricosa*: the former seems to be functional, although it may not contain all the different genomes, namely, ABCDE.

Judging from its morphological characters, the  $F_2$  plant with 43 chromosomes is assumed to have been derived from the pollen of *T. spelta*. As this had a fair number of seeds, its pedigree culture was undertaken (Fig. 5b). Although many of them in  $F_5$  and  $F_6$  had 42 chromosomes (Fig. 4b), some irregularity (univalent, rarely tetravalent, etc.) was observed in the PMC, and sometimes segregation occurred morphologically or chromosomally.

*Back-cross hybrid*: The back-cross by *vulgare* was effected rather easily, and some plants were obtained. The chromosome condition of its progeny (Fig. 3) is seen in Table 4.

TABLE 4. Chromosome conditions in descendants of  
(*Aegilotr.* No. 3  $\times$  *T. vulgare*)  $\times$  *T. vulgare*

$BF_1$	$BF_2$	$BF_3$	$BF_4$	$BF_5$
42(16II)				
43(16II)				
43(17II)				
44(18II)	43(19II)	X	X	42(21II)
X	40(17II)	42(20II)	42(21II)	42(21II)
40(14II)				— 42(21II)
48(17II)				
46(18II)				
42(14II)				

From this result, the number of chromosomes in the fertilized  $F_1$  eggs works out as follows:

2n	Pollen	Egg
40 (1) <sup>(1)</sup>	21	19
42 (2)	21	21
43 (2)	21	22
44 (1)	21	23
46 (1)	21	25
48 (1)	21	27

(1) Number of observed individuals.



Although, theoretically, the number of chromosomes in the fertilized  $F_1$  eggs is expected to be from 14 to 35, *i.e.*, AB—ABCDE, the result of the back-cross showed that the functional egg has numbers ranging from 19 to 27, that is, usually from 21 to 28. So the functional  $F_1$  egg, in many

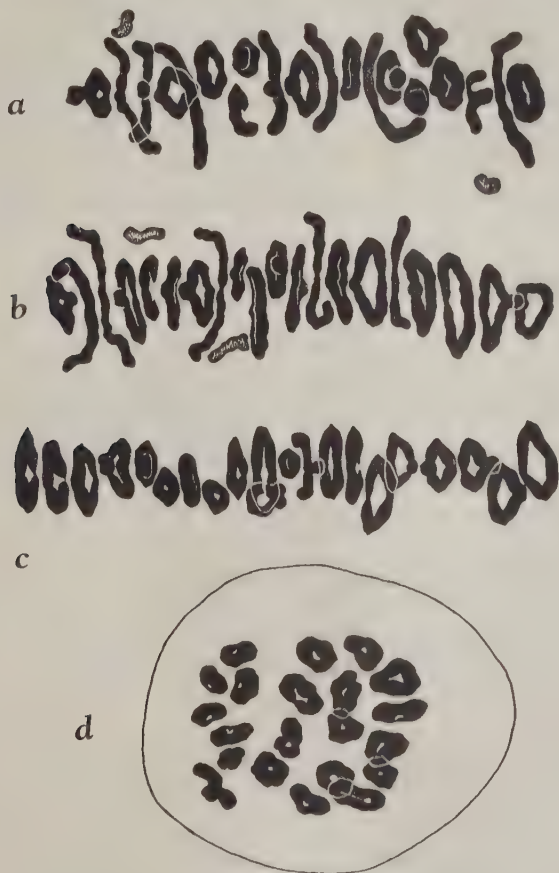


Fig. 4. Chromosomes at first division in PMC of balanced strains. Smear preparation. Strain a, b, c, d (see text p. 347). a-c, Side view. a-b,  $F_5$ . c-d,  $BF_5$ . a,  $20_{II}+2_I$ . b,  $20_{II}+2_I$ . c,  $21_{II}$ . d, a cell in polar view,  $21_{II}$ .

cases, seemed to contain genomes AB and some chromosomes from one or two other genomes.

In this progeny two balanced strains were obtained. One of them could be distinguished from *vulgare*, neither chromosomally (Fig. 4d)

nor morphologically (Fig. 5d). The other strain showed itself to be approximately normal in meiosis (Fig. 4c), although it contained certain *Aegilotriticum* characters (Fig. 5c) and was somewhat unstable.

We shall next consider the formative process of these strains. It was at first supposed that AB combines with either C or D or E, whence three cases were expected, namely, AABBDD as *vulgare*, and two new combinations AABBCD and AABDEE. It is also probable that a genom changed to another genom by interchange of its component chromosomes. To illustrate, if genom D of *vulgare* AABBDD changed to D', either AABBDD' or AABBDD'D' would result. As to which formative process the strain that resulted belongs, should be elucidated by further study<sup>(1)</sup>.

## Fertility in relation to chromosome number

### (1) F<sub>1</sub>, F<sub>2</sub> AND BACK-CROSS PLANTS

*F<sub>1</sub> plants:* As shown in Table 5, the F<sub>1</sub> from *T. durum* × *Ae. ventricosa* and from *Aegilotr.* No. 3 × *T. vulgare* did not produce any seeds when their heads were bagged, although some seeds were obtained from open heads, from which it is assumed that fertilization in these F<sub>1</sub> eggs usually occurred by other normal pollen.

TABLE 5. Fertility of F<sub>1</sub> from *T. durum* × *Ae. ventricosa* and *Aegilotr.* No. 3 × *T. vulgare*

Combination	Pollination	Number of florets	Number of seeds	Fertility (%)
<i>T. durum</i> × <i>Ae. vent.</i>	self	830	0	0.00
	open	2072	21	1.01
<i>Aegilotr.</i> No. 3 × <i>T. vulg.</i>	self	574	0	0.00
	open	2390	15	0.63

*F<sub>2</sub> plants:* The fertility of various individuals varied as shown in Table 6. The F<sub>2</sub> from *T. durum* × *Ae. ventricosa* produced seeds rather well, some of them just like the normal species. Plants with a small number of chromosomes tended to show low fertility.

(1) Genomic analyses of the balanced strains are now being made, although some of them are known to belong to the second of the two processes mentioned above.

TABLE 6. Fertility of  $F_2$  individuals

Number of chromosomes	Number of florets	Number of seeds	Fertility (%)
a. <i>T. durum</i> $\times$ <i>Ae. ventricosa</i>			
46 (18 $_{II}$ )	84	73	86.90
47 (20 $_{II}$ )	330	264	80.00
41 (14 $_{II}$ )	38	1	2.63
44 (17 $_{II}$ )	124	63	50.81
46 (18 $_{II}$ )	122	97	79.51
45 (18 $_{II}$ )	120	29	24.17
43 (16 $_{II}$ )	106	57	53.77
b. <i>Aegilotr.</i> No. 3 $\times$ <i>T. vulgare</i>			
45 (17 $_{II}$ )	298	23	7.72
36 (16 $_{II}$ )	56	0	0.00
43 (17 $_{II}$ )	232	20	8.62

*Back-cross plants:* The  $BF_1$  from (*T. durum*  $\times$  *Ae. ventricosa*)  $\times$  *Ae. ventricosa* and (*Aegilotr.* No. 3  $\times$  *T. vulgare*)  $\times$  *T. vulgare* pro-

TABLE 7. Fertility of  $BF_1$  individuals

Number of chromosomes	Number of florets	Number of seeds	Fertility (%)
a. ( <i>T. durum</i> $\times$ <i>Ae. ventricosa</i> ) $\times$ <i>Ae. ventricosa</i>			
42 (12 $_{II}$ )	238	7	2.94s*
	276	24	8.70
42 (14 $_{II}$ )	244	2	0.82s
	310	8	2.58
36 (12 $_{II}$ )	252	18	7.14s
	150	26	17.33
b. ( <i>Aegilotr.</i> No. 3 $\times$ <i>T. vulgare</i> ) $\times$ <i>T. vulgare</i>			
43 (16 $_{II}$ )	62	3	4.84s
	106	22	20.75
43 (17 $_{II}$ )	76	0	0.00
48 (17 $_{II}$ )	60	0	0.00
46 (18 $_{II}$ )	100	11	11.00
42 (14 $_{II}$ )	76	0	0.00
X	176	27	15.34

\*s means fertility from bagged heads.

duced some seeds in their open or bagged heads, although the extent to which they did so differed with individuals (Tab. 7). Moreover the  $BF_1$  from No. 3  $\times$  *vulgare* seemed to have segregated in fertility or in mor-



Fig. 5. Spikes from 4 balanced strains. Strain a, b, c, d.

phological character (cf. Fig. 3), whereas in the case of *durum*  $\times$  *ventricosa* the  $BF_1$  was rather uniform in character (see Fig. 2).

## (2) SOME BALANCED STRAINS

In four balanced strains denoting newly combined or wheat-like characters (Fig. 5 a-d), the fertility and chromosomal condition was compared from the stand point of generation, as shown in Table 8. The  $F_1$  plants of these strains were obtained in 1930 and the  $BF_1$  of them in 1931. No cultivation being attempted in 1933, the generation in 1936 was  $F_6$  and  $BF_5$ . Four strains were derived from the following crosses. The generation, in which they were balanced, is assumed chiefly from the point of their chromosomal or genetic behaviour.

Strain	Cross	Pedigree No.	Generation balanced
a	<i>T. durum</i> × <i>Ae. ventricosa</i> <sup>(1)</sup>	122	$F_4$ (1934)
b	<i>Aegilotr.</i> No. 3 × <i>T. vulgare</i> <sup>(2)</sup>	112	$F_6$ (1935)
c	(No. 3 × <i>vulgare</i> ) × <i>vulgare</i>	136	$BF_4$ (1935)
d	ditto	106	$BF_3$ (1934)

TABLE 8. Chromosome condition and fertility in some balanced strains

Strain	Numb. of	$F_2$	$F_3$	$F_4$	$F_5$	$F_6$
a	florets	330	122	176	68	358
	seeds	264	108	163	60	324
	fert. (%)	80.00	88.52	92.61	88.24	90.50
	chromos.	47(20II)	43(21II)	X	42(19II)	42(20II)
b	florets	232	126	38	110	244
	seeds	20	77	27	71	183
	fert. (%)	8.62	61.11	71.05	64.55	75.00
	chromos.	43(17II)	40(18II)	41(20II)	42(19II)	42(20II)
		$BF_1$	$BF_2$	$BF_3$	$BF_4$	$BF_5$
c	florets	42	192	40	130	154
	seeds	6	49	13	114	141
	fert. (%)	14.29	25.52	32.50	87.69	91.56
	chromos.	X	43(19II)	X	X	42(21II)
d	florets	ditto	ditto	100	64	212
	seeds			55	57	196
	fert. (%)			55.00	89.06	92.45
	chromos.			42(20II)	42(21II)	42(21II)

(1) Probably fertilized by *vulgare* pollen in the  $F_1$  or later generation.(2) Probably fertilized by *spelta* pollen in the  $F_1$  generation.



As will be seen from the foregoing Table, generally speaking, the more stable the chromosome condition, the higher the fertility, although in some cases fairly high fertility is seen before the stability was reached (cf.  $F_2$  and  $F_3$  of strain a). On the other hand, low fertility sometimes showed itself in a balanced condition, as seen in  $BF_3$  of strain d, which shows that the nature of the combined chromosomes plays an important rôle in maintaining the constancy of individuals.

## Discussion

Breeders usually endeavour to breed new strains by recombining or changing the genes. Recently, the formation of more different or entirely new strains by crossing different genomic species has attracted our special attention. But in such cases we usually meet with an amphidiploid, having the diploid number of both parent chromosomes, which sometimes may result from the fact that the number of chromosomes in the fertilized egg of such  $F_1$  is usually not reduced. But if a single genom is regarded as an unit for the existence of individuals, theoretically speaking, we should expect many other constant types in such hybrid progeny. If we assume two different species  $\alpha$ (AABB) and  $\beta$ (EEFF), then we should expect the following types due to the new combination of genoms.

P	$F_1$	Constant type
$\begin{array}{c} \text{AABB} \\ (\alpha) \\ \\ (\beta) \\ \text{EEFF} \end{array} >$	ABEF	$\left\{ \begin{array}{l} \text{BB} \\ \text{AA} \\ \text{AABB} \\ \text{AABBFF} \\ \text{AABBE} \end{array} \right\} \quad \alpha\text{-like}$
		$\left\{ \begin{array}{l} \text{BBEE} \\ \text{AAEE} \\ \text{AABBEFF} \end{array} \right\} \quad \text{intermediate}$
		$\left\{ \begin{array}{l} \text{AAFF} \\ \text{BBFF} \\ \text{AAEEFF} \\ \text{BBEEFF} \\ \text{EEFF} \end{array} \right\} \quad \beta\text{-like}$
		EE
		FF

On the other hand, an interchange of chromosomes or of their segments<sup>(1)</sup> between different genoms may occur sometimes in such hybrids as follows:

(1) From the study of back-cross hybrids between *Triticum* and *Haynaldia*, KIHARA and NISHIYAMA (1937) has discussed the possibility of crossing-over between semihomologous chromosomes from two different genoms.

<..... A'	A	:	E	E'.....>
a <sub>1</sub>	a <sub>1</sub>		e <sub>1</sub>	e <sub>1</sub>
a <sub>2</sub>	a <sub>2</sub>		e <sub>2</sub>	e <sub>2</sub>
a <sub>3</sub>	a <sub>3</sub>		e <sub>3</sub>	e <sub>3</sub>
a <sub>4</sub>	a <sub>4</sub>		e <sub>4</sub>	e <sub>4</sub>
a <sub>5</sub>	a <sub>5</sub>		e <sub>5</sub>	e <sub>5</sub>
⋮	⋮		⋮	⋮
⋮	⋮		⋮	⋮
e <sub>n</sub>	a <sub>n</sub>		e <sub>n</sub>	a <sub>n</sub>

Thus if the derived genom, owing to the change in its quality, is present, homotypically, a new strain will arise, namely, A'A'BB, E'E'FF...etc.

Further, a chromosome of a genom or its fragment is introduced into another genom and the resultant product sometimes manages to survive. This means a numerical or quantitative change in chromosomes, the constant type thus formed being heteroploid.

<..... A'	A	:	E	E'.....>
a <sub>1</sub>	a <sub>1</sub>		e <sub>1</sub>	e <sub>1</sub>
a <sub>2</sub>	a <sub>2</sub>		e <sub>2</sub>	e <sub>2</sub>
a <sub>3</sub>	a <sub>3</sub>		e <sub>3</sub>	e <sub>3</sub>
a <sub>4</sub>	a <sub>4</sub>		e <sub>4</sub>	e <sub>4</sub>
a <sub>5</sub>	a <sub>5</sub>		e <sub>5</sub>	e <sub>5</sub>
⋮	⋮		⋮	⋮
⋮	⋮		⋮	⋮
	a <sub>n</sub>		e <sub>n</sub>	e <sub>n</sub>
				a <sub>n</sub>

As just mentioned, various types may be expected from the qualitative or quantitative changes in the relation of the chromosomes between different genomes. Some of the reports on the progeny of wheat-rye hybrids seem to bear out this supposition. With the intention of combining some of the economic characters of rye with those of common wheat, such as winter hardiness, etc., many crosses have hitherto been made. Some of the results thus obtained, the cytogenetic formative processes of which are known, might be mentioned. The most remarkable case is that of an amphidiploid type reported by LEWITSKY and BENETZKAJA (1932), and others. Although, as mentioned by LEDINGHAM and THOMPSON (1938), other usual offspring seem to become wheat, and to balance themselves, there sometimes appeared some non-amphidiploids as a more or less constant type. LEBEDEFF (1932) obtained from the back-cross with rye, a strain of 28 chromosomes showing 14 bivalents at meiosis. FLORELL (1931) and KATTERMANN (1937a) reported wheat-like derivatives with certain rye characters, which seemed to add one or sometimes more pairs of rye chromosomes to the wheat complement. The latter author (1937b—

c) obtained also stable 42-chromosomic wheat-like plants, containing some rye chromosomes. Thus we shall hear of more instances in near future.

As to what extent the balanced strains obtained by the writer are stable, and to which of the changes mentioned above they belong, are questions, the answers of which must be given after further studies. The writer wishes merely to point out here the possibility of breeding new strains from the cross of differing genomic species: the  $F_1$  from such crosses begets progenies usually by either back-crossing or open pollination, and only by the selection for the progenies from the point of economic characters we might sometimes be able to obtain some useful strains.

### Summary

(1) In this study the combinations of crosses were *Triticum durum*  $\times$  *Aegilops ventricosa*, *Aegilotriticum* No. 3  $\times$  *T. vulgare*, and their back-crosses by *ventricosa* or *vulgare*.

(2) Usually, the  $F_1$  plant produced some seeds, but only from open heads, although in subsequent generations the fertility in some strains improved quickly.

(3) By counting the number of chromosomes in back-cross individuals, that of functional  $F_1$  eggs was found to be unreduced or almost so in the hybrid between *T. durum* and *Ae. ventricosa*, whereas it was not so in the hybrid between *Aegilotr.* No. 3 and *T. vulgare*.

(4) Some pedigrees showing comparative high fertility were investigated chromosomally, 4 balanced strains a, b, c and d, having 42 chromosomes, were selected for study.

(5) The constant types from the hybrid of different genomic species are considered theoretically.

In closing, the writer wishes to express his hearty thanks to Prof. K. MIYAKE and Prof. K. KOMINAMI for their kind advices.

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## Abstract Nos. 332-488

(Referring to the principal papers in Botany and allied subjects which have appeared in Japan during July-December 1937)

**332. Notes on the Japanese Carices (V).** (Japanese with Latin diagnoses). Shigeo AKIYAMA. (Jour. Japan. Bot. **13**, 1937, 645-659).

The following new species are described among others: *Carex hachijoensis*, *C. aquilonalis*, *C. karashidaniensis*, *C. meridiana*.

**333. Preliminary note on the life-history of *Thorea ramosissima*.** (Japanese with English résumé). Moritosi ARASAKI. (Bot. Mag. Tôkyô **51**, 1937, 715-721, 3 textfigs.).

Solitary monosporangia situated on the basal cell of the assimilation hair branch are abundantly found in winter. The monospore liberated out from each of them through the apical pore begins to produce soon a germ-tube. Through repeated cell-divisions and branching the stage of protonema type of the sporeling (= *Chantransia* stage) is reached. The prothallium as reported by SCHMIDLE was not seen by the author. The microsporangia as reported by MÖBIUS and HEDGCOCK are seen abundantly June-December; they should be regarded as distinct from the monosporangia; their germination was not observed. Neither were the sexual organs found by the author.

**334. Mikrochemischer Nachweis der Flechtenstoffe. (III).-(IV). Mitteilung.** Yasuhiko ASAHINA. (Jour. Japan. Bot. **13**, 1937, 529-536, 855-861, 1 Taf. u. 15 Textfig. im ganzen).

Als neue Reagentien für den Nachweis der Flechtenstoffe empfiehlt der Verf. den Gebrauch von Pyridin, Chinolin, Anilin, ortho-Toluidin, von welchen jedes mit Glycerin, Alkohol oder Wasser gemischt gebraucht wird. Für die Extraktion solcher schwerlöslichen Substanzen ist eine neue einfache Methode angegeben.

Der spezielle Teil, welcher vom Verf. zusammen mit M. MITUNO bearbeitet wird, bezieht sich auf den Nachweis von Leanorsäure, Gyrophorsäure, Olivetorsäure, Anziensäure, Usninsäure, Atranorin, Everssäure, Divaricatsäure, Barbatinsäure, Deffractasäure durch die soeben genannten Reagentien.

Weiter, als die Fortsetzung der früher veröffentlichten Angaben in bezug auf den Nachweis von Flechtenstoffen, die durch Chlorkalk nicht gerötet werden, sind die Nachweisreaktionen von Umblicarsäure, Obtusatsäure (= Ramalsäure von KOLLER und PFEIFFER) erwähnt.

**335. Über den taxonomischen Wert der Flechtenstoffe.** (M. japan. Zfg.). Yasuhiko ASAHINA. (Bot. Mag. Tôkyô **51**, 1937, 759-764).

Der Verf., welcher eine Anzahl von wichtigen Mikromethoden für den Nachweis verschiedener Flechtenstoffe bekannt machen liest, hat, in Übereinstimmung mit dem NYLANDERSchen Prinzip, wonach die spezifischen chemischen Bestandteile als Artenmerkmale verwendet werden sollen, im vorliegenden Aufsatz den taxonomischen Wert der Flechtenstoffe, besonders der im Wasser unlöslichen und somit an Hyphen anhaftend-bleibenden Flechtensäuren besprochen. Früher (vgl. diesen JOURNAL **9**, (33), Nr. 140) hat der Verf. zwei Sätze aufgestellt: 1. Die Flechten, welche morphologisch ganz gleichartig sind und doch chemisch verschiedene Bestandteile enthalten, sind

als verschiedene Arten aufzufasse, und 2. Die Mengenverhältnisse der in einer und derselben Flechtenart enthaltenen zwei oder mehreren chemischen Substanzen können unter Umständen recht stark variieren. Die Beachtung dieses zweiten Satzes wird die unnötige Artzergliederung vermeiden lassen. Die obigen zwei Sätze sind durch einige lehrhafte Beispiele erläutert.

Unter den Pilzen und Gonidien, welche eine Flechte zusammensetzen, wird ihre Gestalt hauptsächlich durch den Pilz bestimmt. Die Gonidien, obgleich sie äusserlich zueinander ganz ähnlich zu sein scheinen, können in ihrem Chemismus und daher in ihren Stoffwechselprodukten recht verschieden sein. Die Ursache, warum nicht selten die morphologisch ganz identischen Flechten durch das Enthalten ganz verschiedener Stoffe ausgezeichnet sind, ist daher leicht zu verstehen. Wenn die Flechten, welche aus einer morphologisch gleichen Pilzart bestehen, die in ihrem Chemismus verschiedenen Gonidien enthalten, wie soeben angedeutet, sind sie als verschiedene Arten aufzufassen.

**336. Effects of the relative length of day and night before and after bud differentiation on formation and development of flower bud III.** (Japanese).—**Ibid IV. Experiments with rice, barley and wheat.** (Japanese).—**Ibid V.** (Japanese with English résumé).—**Effects of the day length upon the time of differentiation of flower bud and the subsequent development to flowering.** Tsuneo EGUCHI. (Jour. Hortie. Assoc. Japan 7, 1936, 252-316, 76 text-figs.; 8, 1937, 1-71, 69 text-figs., 203-234, 28 text-figs.; Proc. Imp. Acad. 13, 1937, 332-333).

Since the appearance of the well-known investigations of GARNER and ALLARD on the photoperiodism of certain plants a great number of researches upon the same subject concerning many plants were made by various authors. The present author has done also similar experiments on a certain number of plants which were begun in 1931 and continued for six years. The most noteworthy fact contained in the results of his studies is that the photoperiodic treatment produces often quite contrary effect according as it is performed before or after the differentiation of flower bud. In consideration of this notable fact the author could distinguish nine groups of plants. In the first group (strawberry, *Primula malacoides*, *Cineraria hybrida*), when the plants are subjected to short day treatment (9 hours illumination per day) before the flower bud differentiation this process itself and the flowering take place earlier than in the control or the plant subjected to long day treatment (24 hours illumination). But when the same short day treatment is performed after the flower bud had been completely differentiated, a quite contrary effect will come out, inasmuch as plants subjected to long day treatment will bear flowers earlier than the control or those of short day treatment, so that the plants belonging to the first group may be said, as it were, to be both long- and short day ones at the same time. Such plants are denoted by SL (S= short, L= long) by the author. In the second group (*Silene pendula*, *Chrysanthemum leucanthemum* and two spring varieties of barley) the long day treatment hastens both the differentiation of flower buds and the flowering, so-called LL plants. In the third group (*Phytostegia virginiana* and *Boltonia latifolia*) the long day treatment hastens the flower bud differentiation, and the short day treatment after this process had been completed hastens the flowering, LS plants. Plants included in the fourth group (bean, morning glory and *Cosmos bipinnatus*) are SS ones. In plants belonging to the fifth group (*Phlox paniculata*) the long day treatment hastens the flower bud differentiation, but either the long or short day treatment after the completion of that process has no effect at all—LI plants (L= indifferent). Fur-

ther, the sixth group (three late rice varieties) = SI, the seventh (*Chrysanthemum arcticum*) = IS, the eighth (spinach and five wheat varieties) = IL, the ninth (pepper and 1 early rice variety) = II.

**337. Die thermenbewohnenden Pflanzen und Tiere.** (Japanisch). Yoshikadzu EMOTO. (Sonderabdruck aus Rigakukwai **35**, 1937, 15 S., 1 Taf. und 5 Textabb.).

In Japan sind die Thermen verschiedener Arten reichlich vorhanden, 5889 im eigentlichen Japan, 20 in Formosa und 50 in Korea. Die dort bewohnenden Pflanzen sind vor allem die Bakterien (Schwefel- und Eisenbakterien, wie *Beggiatoa*, *Rhodospirillum*, *Chromatium*, *Thiobacillus*, *Leptothrix*, *Gallionella*), die Cyanophyceen (*Oscillatoria*, *Nostoc*, *Mastigocladus*, *Rivularia*, *Chroococcus*, *Phormidium*, *Lyngbya*, *Gloeocapsa*, *Synechocystis*), die Conjugaten (*Cosmarium*, *Closterium*, *Mougeotia*, *Spirogyra*), die Diatomeen (*Navicula*, *Cymbella*, *Fragilaria*, *Nitzschia*, *Synedra*, *Gomphonema*), und die Flagellaten (*Euglena*, *Mastigamoeba*). Bezüglich den thermenbewohnenden Tiere sind nur wenige bekannt.

Alle bisher in Japan gefundenen Pflanzen und Tiere in den Thermen sind tabellarisch zusammengestellt. Auch die Geschichte ihrer Untersuchungen in Japan ist in diesem Aufsatz kurz geschildert.

**338. Untersuchung über die Entwicklung der Myxomyceten auf den faulenden Hölzern.** Yoshikadzu EMOTO. (Japan. Jour. Bot. **9**, 1938, 253-257, 3 Tabellen).

**339. Die Anpassungsfähigkeit der Pflanzen bezüglich des osmotischen Druckes I. Vorliebe der Halophyten für NaCl.** (Mit japan. Ztg.). YASONA FUKUDA. (Bot. Mag. Tōkyō **51**, 1931, 445-456, 6 Textfig., 617-618).

Es ist eine wohlbekannte Tatsache, dass der osmotische Wert der Pflanzenzellen mit der Zunahme der Konzentration des Nährmediums allmählich ansteigt. Der Verf. hat z.B. die Epidermiszellen des Stengels des jungen Keimlings einer Halophytenart *Plantago Coronopus* in gewisse Salzlösungen während 1-2 Wochen lang eingestellt, und dann das in Rede stehende osmotische Verhältnis untersucht. Danach erhöht sich der osmotische Wert der untersuchten Zellen mit der aufsteigenden Konzentration des Kulturmediums, bis er ein Maximum erreicht, worauf mit der weiteren Zunahme der Mediumkonzentration die Erniedrigung des osmotischen Wertes erfolgt und der Tod der Zellen eintritt. Dabei ist es höchst merkwürdig, dass die maximale Konzentration in der kochsalzfreien Nährlösung bloss 24 Atm. beträgt, während er in der kochsalzhaltigen fast doppelt betragen kann (d. h. 41 Atm.), was die Vorliebe der Halophyten für Kochsalz andeutet. Wenn man aber bei gleichartigen Experimenten eine Glykophytenart *Andropogon Sorghum* statt der obengenannten Halophytenart *Plantago Coronopus* vornimmt, so wird man sehen, dass in der Kulturlösung entweder mit oder ohne Kochsalz die untersuchten Zellen bloss einen Mediumdruck bis zu 22 Atm. ertragen können und bei seiner weiteren Steigerung zugrunde gehen.

Der Verf. hat auch in bezug auf die im Wasserkultur befindlichen Pflanzen die gleichartigen Experimente ausgeführt, und das osmotische Reaktion der oberirdischen Teile untersucht. Dabei bei der Glykophytenart *Plantago major* war kein Reaktionsunterschied in der Kulturlösung, entweder mit oder ohne Kochsalz nachzuweisen, aber bei der Halophytenart *P. Coronopus* war ein deutlicher Unterschied zu beobachten. Der osmotische Wert der Glykophyten erhöht sich nämlich unter dem Einfluss der Mediumkonzentration schneller als derselbe der Halophyten, und dabei ist es zu bemerken, dass der niedrigere osmotische Zustand bedeutet, dass die Pflanzen ohne



Schwierigkeit Wasser aufnehmen können. Was das Verhältnis zwischen dem osmotischen Wert der Epidermis- und Pallisadenzellen eines Blattes ist derselbe der ersteren niedriger als derselbe der letzteren. Mit der Steigerung der Mediumkonzentration erhöhen sich beide die osmotischen Werte sowie die Saugkraft des Blattes. Wenn die Mediumkonzentration 6 Atm. überschreitet, vergrößert sich der osmotische Wert nicht so steil wie zuvor, während die Saugkraft ebensoviel anzusteigen fortsetzt, sodass schliesslich beide gleich kommen. Woher die Epidermiszellen des Blattes verwelken früher als die Pallisadenzellen, weil, wie oben erwähnt, der osmotische Wert der ersteren niedriger ist als derselbe der letzteren. Das oben beschriebene betrifft den Fall des kochsalzfreien Nährmediums. Im kochsalzhaltigen Medium ist es etwas anders: in hochkonzentriertem Nährmedium nämlich ist der osmotische Wert der Pallisadenzellen niedriger als derselbe der Epidermiszellen, sodass mit der Steigerung der Mediumkonzentration über 6 Atm. die Saugkraft vor allem mit dem osmotischen Wert der Epidermiszellen gleichkommt, worauf die Pallisadenzellen früher als die Epidermiszellen verwelken.

Betreffend die quantitative Beziehung zwischen der Mediumkonzentration und dem osmotischen Wert der Zellen, soll nach einigen Autoren (STANGE, BÄCHER) eine geradlinige Verhältnis bestehen (d. h.  $y = a + bx$ ), während nach einigen anderen (RYSSELBERGHE, POMA) die Zunahme des osmotischen Wertes mit der Steigerung der Mediumkonzentration nach dem WEBERS Gesetz sich vollziehen soll (d. h.  $y = k \log x$ ). Nach den Verfs. Untersuchungen ist das in Rede stehende Verhältnis nicht immer einheitlich und man hat in verschiedenen Fällen mit einer von zwei obigen Alternativen zu tun.

**340. Relation of aphids to the transmission of legume mosaics (1).** (Japanese with English résumé). Teikichi FUKUSHI. (Jour. Soc. Sapporo Agric. and Forest. **29**, 1937, 189-216, 5 pls.).

It seemed to the author very improbable that the mosaic disease of pea and broad bean seen in Sapporo for the first time in the summer of 1935 is transmitted through seeds, and he thinks that it might be transmitted much more probably through red clover cultivated nearby and suffering from mosaic disease by the agency of certain species of aphids, for instance, *Myzus persicae* SULZ.

The experiments of the author concerning this subject are briefly as follows. The aphids above cited were fed on the tobacco seedlings, because they seem to flourish much better on them than on other plants. For the purpose of infection aphids were fed on diseased leaves of red clover, and 5 minutes suffice to let them acquire the virus. If the aphids fed on such a way are placed soon on leaves of healthy plants of broad bean and red clover for 10 minutes, the transmission of the disease was clearly observed. It seems then that the red clover virus does require almost no incubation period in aphids for transmitting the disease. It was further demonstrated that the aphids carrying the red clover virus, will lose their virulence after being fed on healthy plants for 30 minutes. For further details cf. the original.

**341. An insect vector of the dwarf disease of rice plant.** Teikichi FUKUSHI. (Proc. Imp. Acad. **13**, 1937, 328-331, 1 text-fig.).

The leafhopper known by the name *Nephrotettix apicalis* var. *cincticeps* was considered hitherto to be the sole agent of transmission of the rice mosaic disease. Another leafhopper, *Deltocephalus dorsalis* was proven by the author's repeated experiments to be another agent in this respect. When the leafhopper reared on diseased rice plant, beginning from the egg till the adult stage, is enclose in a glass tube

together with healthy rice plant numerous white flecks or stripes were produced on it in certain cases, which are quite indistinguishable from early symptoms of the dwarf disease. The insect was then transferred repeatedly to another glass tube containing healthy rice plant, and often white flecks or stripes were again and again produced on it. The transmission of dwarf mosaic disease by the insect was thus demonstrated. It may be added that in such cases the tissues of the affected leaves always contain the inclusion bodies characteristic of the mosaic disease, and which are those seen in the case of the dwarf disease transmitted through the agency of *Nephotettix*. (Cf. this JOURNAL 8, (3), No. 6).

**342. *Studia orchidacearum japonicarum*. IX. Orchidaceae novae micronesinae a T. HOSOKAWA collectae.** (With Japan. résumé). Noriaki FUKUYAMA. (Bot. Mag. Tôkyô 51, 1937, 900-906, 6 text-figs., 938-939).

The following new species are described: *Dendrobium nanaranticolum*, *D. implicatum*, *D. pseudo-Krameri*, *Microtatorchis Hosokawae*, *Taeniophyllum trukense*.

**343. Studies on the chromosome number in Paridae. (Preliminary note).** (Japanese). Kazuo GOTOH. (Japan. Jour. Gen. 13, 1937, 209-210).

The basic chromosome number of the Paridae is 5, not 6, as formerly stated by the author himself. According to the results of his new investigations  $n = 5$  and  $2n = 10$  in *T. sessile*,  $n = 10$  and  $2n = 20$  in *Paris quadrifolia*,  $2n = 10$  in *Trillium grandiflora* and *erythriocarpus*. In *Trillium recurvatum* mostly  $n = 5$ , rarely 6 and  $2n = 10-12$ , in *T. declinatum*  $n = 5$  and  $2n = 10$  with some chromosome fragments.

**344. Genom and polyploidy in the genus *Trillium*. I. Chromosome affinity between the genoms.** (With Japan. résumé). Tutomu HAGA. (Japan. Jour. Gen. 13, 1937, 135-145, 8 text-figs.).

*Trillium Hagae* is a natural hybrid of giant nature ( $2n = 15$ ) which has arisen probably through the crossing *T. kamtschaticum* ( $2n = 10$ ) and *T. Tschonoskii* ( $2n = 30$ ). The somatic complement of *T. Hagae* is composed of three sets called  $K_1$ ,  $K_2$  and T respectively, each of which contains 5 chromosomes. The chromosomes of the set  $K_1$  are quite similar to those of *T. kamtschaticum*, while those of  $K_2$  and T are quite similar to those of *T. Tschonoskii*. 5 chromosomes in  $K_1$  and  $K_2$  are exactly similar to each other, except some ones where the shorter arm is shorter in  $K_2$  than in  $K_1$ . The chromosomes of T also much resemble those of  $K_1$  and  $K_2$ , but are somewhat smaller.

In the metaphase of PMCs the pairing takes place according to the mode  $5_{II} + 5_I$ , where evidently the chromosomes of the same type in  $K_1$  and  $K_2$  form the bivalents and those in T the univalents. Occasionally some trivalents are observed which are due to the pairing of the chromosomes of the same type in  $K_1$ ,  $K_2$  and T.

On the basis of such observations the genoms of *T. kamtschaticum*, *Hagae* and *Tschonoskii* are to be considered as  $K_1K_1$ ,  $K_1K_2T$  and  $K_2K_2TT$  respectively.

**345. Karyotype polymorphism in *Paris hexaphylla* CHAM., with special reference to its origin and to the meiotic chromosome behavior.** Tutomu HAGA. (Cytologia, FUJII Jub. Vol., 1937, 681-700, 24 text-figs.).

The diploid form of *Paris hexaphylla* contains 5 pairs of chromosomes, of which three, viz. A, B, and E are always constant, while some difference in C and D chromosomes leads to the distinction of five types. The type CCDD is regarded as the typical homozygote. The type CC-DD is distinguished by the fact that one of the C-pair



has its short arm deficient in its length in comparison to that in the type and others. In the type CCDD- one of the D-pairs is deprived of its trabant. In the type CC-DD+ the short arm in one of the C-pair is deficient in length, while in one of the D-pair the trabant is increased in its length.

Basing on the results of comparative measurement the author thinks that the deficiency of the short arm length is due to the deletion, and the length increase of the trabant to the translocation of a small segment from the short arm of C to the distal end of the trabant. Such deletion and translocation may be due to the environmental factors, especially the temperature, as may be guessed from the results of several modern experiments. Besides the diploid forms the author has seen the triploid forms, of which two types may be distinguished, viz. CCCDDD and CCC-DD-D, the sign - denoting the deficiency of the short arm length as in diploid types above indicated.

The distribution of chromosomes in the anaphase goes on generally regularly. In the triploids each of 5 trivalents segregates into 1 and 2 chromosomes.

The heteromorphic short arm in C and D was observed to segregate equationally as well as reductionally in the first anaphase, the ratio of both kinds of segregation being 1.0:5.3 in CCDD diploid.

Diploids, triploids and their various karyotypes seem to have the relation, neither to geographical nor ecological conditions, because all of them were found to live together in one and the same locality.

**346. Chromosome complement of *Kinugasa japonica* with special reference to its origin and behavior.** Tutomu HAGA. (Cytologia **8**, 1937, 137-141, 2 pls. and 1 text-fig.).

The gametic complement of *Kinugasa japonica* TATEWAKI et SUTÔ is composed of 20 chromosomes. Their five types are distinguishable, viz. A, B, C, D and E, of which one is provided with a large trabant and another with a fine seta-like one. Each type is represented by 4 chromosomes, so that on the whole 20 chromosomes are present. In the first metaphase of PMC the chromosomes of each type forms the bivalent, i.e.  $A_{II} + B_{II} + C_{II} + D_{II} + E_{II}$ , and the division is quite regular. Sometimes however irregularities occur, such as non-pairing, fragmentation-fusion, tertiary splitting and the regression of the first division; in consequence of such irregular behavior few or no good pollen at all are formed.

**347. On a mutable gene of the seed coat colour in *Pharbitis Nil*.** (Japanese with English résumé). Tokio HAGIWARA. (Japan. Jour. Gen. **13**, 1937, 185-192, 2 text-figs.).

In carrying out the cross between a brown-seeded and a white-seeded variety of *Pharbitis Nil* the author could discern in the latter a recessive gene  $b_r$  which was proven to be unstable. In  $F_2$  generation of this cross brown and white were segregated out in the ratio 3:1, and besides some black-seeded offspring were got at the same time, which, according to the author, should be due to the reversion of brown into black caused by the mutation of  $r$  b gene. Such mutation was seen to take place, not only in the reproductive cells, as just stated, but also in vegetative ones. Thus, for instance, on the stem of brown individuals in  $F_2$  derived from the above cross some brown-seeded pods containing the mixture of black and black-striped brown seeds were obtained.

**348. Observationes ad plantas Asiae Orientalis (XIV).** (With Japan. résumé). Hiroshi HARA. (Jour. Japan. Bot. **13**, 1937, 600-607).

The following new species are described: *Gentiana Yabei*, *Scutellaria tsusimensis*, *S. amabilis*, *S. Kurokawae*, *Didickea japonica*. A key for the determination of 12 species of *Scutellaria* is given.

**349. Preliminary report on the flora of Southern Hidaka, Hokkaido (Yezo), XXI, XXII, XXIII.** (With Japan. résumé). Hiroshi HARA. (Bot. Mag. Tôkyô **51**, 1937, 635-642, 669, 838-846, 875, 891-899, 938).

**350. On the distribution and construction of the resin-canal in *Rhus succedanea*.** (With Japan. résumé). Morisige HARADA. (Bot. Mag., Tôkyô **51**, 1937, 846-856, 13 text-figs. 875-876).

Since hitherto the investigation of the resin-canals in the genus *Rhus* seems to have been done simply on *R. vernicifera*, the author has performed some observations on certain other species, especially *R. succedanea*.

The general results of his anatomical researches are briefly as follows. In the stem of the seedling of *R. succedanea* 4 resin-canals are present in the phloem, but none in the pith. In the young stem which has just sprouted out from the bud many resin-canals are seen both in the phloem and pith. Resin-canals in the phloem run parallel to the vascular bundles and end blindly. Though in the petiole of the cotyledon only 2 resin-canals are seen, in that of leaflets 4 of them are present. The petiole and midrib of a well developed leaf has 4 large resin-canals and some additional small ones. 4 resin-canals are seen in the very young root, but in old root aged 3-4 years 4-6 canals are present in the primary part of its bast, and 10-20 in its secondary part of the latter. The sepals and petals have each one resin-canal, and the mesocarp of the fruit its great number.

**351. Beobachtungen über die Beziehungen zwischen der Temperatur und der Entwicklung des Pilzes, *Leveillula taurica* (LÉV.) ARNAUD.** (Japanisch). Yosio HASHIOKA. (Jour. Japan. Bot. **13**, 1937, 669-672, 1 Textfig.).

Die endophytische Erysiphee, *Leveillula taurica* wird in Formosa auf *Capsicum annuum* und *Papaver somniferum* parasitierend gefunden, aber in temperierten Regionen Japans noch nicht entdeckt. Ob diese Tatsache dem Unterschied der in beiden Regionen herrschenden Temperatur zuzuschreiben ist oder nicht, wurde von dem Verf. untersucht mittelst einigen Experimenten, wonach die Keimung der Konidien sowie das Längenwachstum des Keimschlauches zwischen 22-31° C stattfinden, und zwar 22° als das Optimum. Solche Temperaturen sind von denen, welche man bisher bei der Pilzuntersuchung in der temperierten Regionen beobachtet hat, nicht besonders verschieden. Daher kommt der Verf. zum Schluss, dass der unter Rede stehende Pilz an temperierten Regionen Japans nicht lebt, weil nicht die dort herrschende Temperatur für sein Gedeihen zu niedrig ist, sondern weil dabei ein anderer noch unbekannter Grund vorliegen dürfte.

**352. The fruit-body of *Pachyma Hoelen* RUMPH.** (Japanese with English résumé). Akira HASIMOTO. (Jour. Japan. Bot. **13**, 1937, 824-825, 2 pls. and 4 text-figs.).

The fresh sclerotium of Japanese "bukuryô" (*Pachyma Hoelen* RUMPH.) (cf. No. 354) was kept perfectly dry for about one month, and then embedded in wet sand during two years, pouring water at a certain interval. Hereafter about one-tenth part of the whole sclerotium body was exposed out of sand, the remaining part resting in sand as before; no water was added during this time. Some time after white mould-like substance began to appear on the surface of the sclerotium, which

has finally developed into a fruit-body. Thus the author has succeeded by means of the so-called "dry method" in forcing the sclerotium to the formation of the fruit-body, which is otherwise hardly obtainable. Two plates contained in this paper represent the photographs of a sclerotium with its fruit-body as well as its longitudinal sections.

**353. Contributiones ad dendrologiam nipponiae australis (III).** (With Japan. résumé). Sumihiko HATUSIMA. (Jour. Japan. Bot. **13**, 1937, 674-683, 2 text-figs.).

The following new plants are described generally with illustrations: *Psychotria liukuensis* sp. nov., *Rubus sacrosanctus* hybrid nov., *R. kyusianus* hybrid nov., *Clerodendron Ohwii* sp. nov.

**354. Fruit-body of "bukuryô".** (Japanese). Iwao HINO. (Jour. Japan. Bot. **13**, 1937, 672-674, 2 text-figs.).

The scientific name of the Japanese "bukuryô" is generally considered to be *Pachyma Cocos*. The comparison of the Japanese specimen with that in „Muséum d'Histoire naturelle" in Paris has convinced the author of the correctness of this scientific name. This was further confirmed by the observation of the fruit-body of the Japanese specimen which has recently reached the author's hands. The name should be therefore rightly *Pachyma Cocos*. (Cf. No. 352).

**355. On the growth of the growing shoot of *Sasa kurilensis*.** (Japanese). Keinosuke HIRAMATU. (Ecolog. Studies **3**, 1937, 254-256, 2 graphs).

By measuring the growth of the growing shoot of the Japanese bamboo, *Sasa kurilensis* during the period extending from June 23 to July 7 the author has got its growth curve. The fact was proven that the latter varies considerably in each individual. When the daily growth on one hand and the external conditions (temperature, humidity and rainfall) on the other are compared to each other, it is seen that the growth curves got during the periods June 4-27 and July 2-4 run nearly parallel to the temperature curve, which proves that the growth is then chiefly regulated by the temperature. During the period June 28-July 1 the temperature changes quite slowly, and yet the growth intensity varies considerably which is evidently due chiefly to the influences of the increase of humidity in consequence of rainfall.

In general the growth is greater at day than at night, but the reverse may take place, and consequently the growth curve does not show the regular rise and fall corresponding to the alternation of day and night.

**356. Respiration of the shoot of *Sasa kurilensis* during its growth.** (Japanese with English résumé). Keinosuke HIRAMATU. (Ecolog. Studies **3**, 1937, 233-238, 3 text-figs.).

According to the results of the author's measurement of the growing shoot of *Sasa kurilensis* extending from the end of June to the beginning of July 1936, the intensities of respiration at day and night were nearly equal. When however in late July the shoot becomes large and green, the intensity of respiration was reduced in the day time, which is in all probability due to the influence of the photosynthetic activity of the shoot. The chief factor which influences the respiration is the air temperature, though the soil temperature may occasionally be considered as such. In the case of high photosynthetic activity light is the limiting factor.

**357. Effect of light and temperature on the change of colour of leaves of *Cryptomeria japonica* in winter.** (Japanese with English résumé). Keinosuke HIRAMATU. (Ecolog. Studies **3**, 1937, 294-308, 5 text-figs.).

Through the formation of some pigments in the chloroplasts contained in leaves those of *Cryptomeria japonica* become orange-red in winter. The relations of this colouring process to the light and temperature, as studied by the author, may be summarized briefly as follows. Under natural conditions low temperature and intense light favour apparently the pigment formation. In order to study the disappearance of this pigment the plants were placed on one hand under constant temperature and illumination, and on the other under natural condition. The following facts were thus ascertained: high temperature leads to the decomposition of the pigment, while intense light prevents such a process. This effect of light is very conspicuous under the temperature lower than 20°C, but becomes almost zero at 20°C.

**358. On CO<sub>2</sub>-assimilation of the light- and shade-leaves on the same tree.** (Japanese with English résumé). Keinosuke HIRAMATU. (Ecolog. Studies 3, 1937, 136-146, 5 text-figs.).

*Ilex Sugeroli* subsp. *brevipedunculata* and *Sorbus japonica* were taken for the materials of experiment. The results of the author's observations are briefly as follows. On sunny day light leaves assimilate more vigorously in forenoon than in afternoon, though on cloudy day no such difference is observed. In shade leaves there is no relation at all between the assimilation and weather condition. The amount of CO<sub>2</sub> assimilated by light and shade leaves are in the ratio 3:1 for *Ilex* and 6:1 for *Sorbus*, if the unit surface area is taken as the basis of measurement, but in both plants this ratio is 2:1, if the unit weight of dry matter is taken for that basis.

**359. Miscellaneous notes on the East-Asiatic Uredinales with special reference to the Japanese species.—Notes on the Japanese species of *Uromyces*.** (Japanese). Naohide HIRATSUKA. (Jour. Japan. Bot. 13, 1937, 587-594, 729-747).

In the first of the two papers above mentioned, 11 species of *Uromyces*, 14 of *Puccinia*, 1 from each of the genera *Hemileia*, *Melampsora*, *Chnoospora*, *Phakospora*, *Barleyella* are enumerated with their localities, etc.

In the second the history of investigation of *Uromyces* in Japan is described, and 73 species which were hitherto recognized in Japan are enumerated. A table indicating their distribution in the world is given.

**360. Conclusive summary of the positive results of the inoculation experiments with heteroecious species of the Japanese rust fungi (1899-1936).** (With Japanese résumé). Naohide HIRATSUKA. (Trans. Tottori Soc. Agric. Sc. 6, 1937, 122-134).

Since the inoculation experiment to prove the genetic relationship between the aecidial stage of *Cronartium quercuum* and *Peridermium giganteum* by SHIRAI in 1899, a great number of similar experiments on various rust fungi have been performed. The author gives in this paper an extensive table of such inoculation experiments done by various authors between 1889-1936. The number of the species thus studied is 38 in Melampsoraceae (10 genera) and 26 in Pucciniaceae (4 genera).

**361. Chromosome number in plant species allied to those of the genus *Oryza*.** (Japanese with English résumé). Isao HIRAYOSHI. (Japan. Jour. Gen. 13, 1937, 215-216).

The subfamily Oryzoideae contains two tribes, viz. Oryzeae and Zizanieae. When we consider the chromosome number in various species of the former tribe it will be seen that its basic number is 12, and the somatic number a certain multiple of the latter. Thus, for instance, *Oryza sativa*, *Hygroryza aristata*, *Chikusichloa aquatica*



contain each 24 somatic chromosomes, *Leersia hexandra* 48, *L. oryzoides* var. *japonica* 60, *L. japonica* 96. In *Zizania latifolia* belonging to the second of the two tribes above mentioned the basic number is 17 and consequently  $2n = 34$ .

**362. Some cyanophycean algae from Hokkaido. (I), (II), (III).** (Japanese). HIROYUKI HIROSE. (Jour. Japan. Bot. **13**, 1937, 492-499, 569-572, 794-804, altogether 32 text-figs.).

The following are enumerated with illustrations: *Microcystis* (4 sp.), *Aphanocapsa* (4), *Chroococcus* (2), *Aphanothece* (3), *Gloeothece* (1), *Coelosphaeria* (2), *Merismopedia* (1), *Dactylococcopsis*, (1), *Chaemosiphon* (2), *Xenococcus* (1), *Capsosira* (1), *Stigonema* (1), *Hapalosiphon* (1), *Calothrix* (3), *Rivularia* (4), *Isactis* (1).

**363. Nuntia ad floram japoniae XXXIII, XXXIV.** (With Japanese résumé). MASAZI HONDA. (Bot. Mag., Tôkyô **51**, 1937, 643-646, 669-670, 857-859, 876-877).

The following plants are recorded as new: *Ajuga pallescens* MAKINO var. *hirsuta* var. nov., var. *stenophylla* var. nov., *Rosa polyantha* SIEB. et ZUCC. var. *glabrescens* var. nov., *Euonymus alatus* SIEB. var. *subtriflora* FR. et SAV. forma *angustatus* comb. nov., *Clematis paniculata* THUNB. forma *Maximowicziana* comb. nov., *Struthiopteris castanea* NAKAI var. *viridipes* var. nov., *Elaeagnus pungens* THUNB. var. *latifolia* var. nov., *Solidago hachijoensis* NAKAI var. *elata* var. nov., forma *squamipes* f. nov., *Solidago japonica* KITAMURA var. *ovata* var. nov., var. *paludosa* comb. nov., *Aucuba japonica* THUNB. var. *brachyphylla* var. nov., *Pinellia ternata* BREITENBACH forma *subeuspadata* f. nov., *Ajuga decumbens* THUNB. forma *purpurina* f. nov., *Leontopodium japonicum* MIQUEL var. *angustifolium* var. nov., *Festuca ovina* L. forma *straminea* f. nov., *Ajuga incisa* MAX. forma *rosea* f. nov., *Deutzia Sieboldii* KOERN. var. *megaphylla* var. nov., *Platycodon glaucum* NAKAI var. *typicum* HONDA forma *albiflorum* f. nov., *Lysimachia Fortunei* MAX. var. *pilophora* var. nov., *Vicia japonica* A. GRAY forma *albiflora* f. nov., *Poa uda* sp. nov.

**364. Studien über die Lebensformen der höheren Pflanzen in Japan-Hondô.** (Japanisch). YOSHIWO HORIKAWA und WAKASI SATÔ. (Oekol. Studien **2**, 1936, 96-104, 200-210, 6 Textfig.). — **Wert des Kryptogamenquotienten gegenüber der Verbreitungstheorie.** (Japanisch m. engl. Zfg.). Von denselben Verff. (Ibid **3**, 1937, 61-69). — **Studien über die Lebensformen der Phanerogamen in Japan-Hondo und über das PtpH-Q in Japan.** Von denselben Verff. (Jour. Sc. Hiroshima Univ. Ser. B, Div. 2, **3**, 1938, 57-67, 5 Taf., 1 Textabb.).

Der Hondo genannte Teil von Japan besteht aus Honsyû (Nippon der europäischen Autoren), Sikoku und Kyûsyû, und liegt unter etwa  $31^{\circ}$ – $41^{\circ}.5$  nördl. Br. Die mittlere Jahrestemperatur des ganzen Hondos ist  $13.5^{\circ}\text{C}$ , dieselbe in Kagosima und Aomori  $16.7^{\circ}$  bzw.  $9.3^{\circ}$ . Die mittlere Regenmenge ist in ganzen Honsyû 1660 mm, 2184 mm in Kôti und 994 mm in Nagano.

Die Verff. haben die Lebensformen von 3601 Arten und 850 Varietäten der Phanerogamen nach dem Muster von RAUNKIAER studiert, und das daraus bekommene biologische Spektrum mit seinem Normalspektrum verglichen. Das Resultat dieser vergleichenden Studien steht wie folgt:



	MM										HH		Th	
	S	E	Mg	Ms	M	N	Ch	H	G		Hi	Hd	Th. s	Th. w
Verff.	0.03	0.83	0.86	7.78	11.11	8.66	2.02	47.38	8.02		1.83	1.86	8.83	1.22
RAUN- KIAER	2	3	8	18	15	9	26	4			2		18	

S = Stammsukkulent, E = Epiphyt, MM = Phanerophyt, Mg = Mega-, Ms = Meso-, M = Mikro-, N = Nanophanerophyt, Ch = Chamaephyt, H = Hemikryptophyt, G = Geophyt, Hi = Helophyt, Hd = Hydrophyt, Th = Therophyt, Th. s = Sommer-, Th. w = Wintertherophyt.

Wie man aus der obigen Tabelle sieht, ist der Prozentsatz von Hemikryptophyten 47.38, d.h. das Klima der unter Rede stehenden Region ist hemikryptophytisch, und dabei ist es eigentümlich, dass hier der Schwerpunkt der Phanerophyten in den Mesophanerophyten liegt, im Gegensatz zu den anderen Regionen mit dem gleichen Klima. Die Lianen, die keine Winterknospen tragen, sind in den Wäldern in südlichen Japan (warmtemperierten) vertreten. Es giebt sehr wenige Chaemäphyten, welche sich in der Arktis, den Bergen und den trockenen Meeresküsten beschränkt befinden. Die Geophyten, welche ungefähr doppelt vertreten sind als im Normalspektrum, gehören meistens zu den Monokotyledonen, welche sich in den nördlichen kalttemperierten Regionen befinden. Der Prozentsatz der Therophyten ist 10, welche besonders durch Sommertherophyten dargestellt werden.

Der Pteridophyten-Quotient, welcher mittelst der Formel,  $Ptph-Q = B : \frac{A}{25}$  ausgerechnet wird (B = Artenzahl der Pteridophyten, A = dieselbe der Phanerogamen), ist 1.4 in Karahuto (Saghalien), 1.5–1.8 in den kalttemperierten Regionen, 2.3–5 in den warmtemperierten, und 4.1 in Formosa. Der grösste Wert 6.2 wurde in den Bonin Inseln aufgefunden, welche eine ozeanische, vom Festlande weit entfernte Lage haben.

**365. Materials of the botanicaal research towards the flora of Micronesia (XVI).** Takahide HOSOKAWA. (Jour. Japan. Bot. **13**, 1937, 608–617, 17 text-figs.).

Several plants of Micronesia from each of the families Ophioglossaceae, Podiaceae, Selaginellaceae, Myrsinaceae, Verbenaceae, Rubiaceae, Cucurbitaceae are enumerated. *Astronidium kusaianum* sp. nov. is described with some illustrations.

**366. Contributions to the knowledge of the systematics of *Morus* in Japan IV.** (With Japan. résumé). Teikichi HOTTA. (Bot. Mag. Tōkyō **51**, 1937, 688–694, 722, 1 text-fig.).

A key for the determination of varieties and forms of *Morus bombycis* cultivated in Japan is given. All contained in this key are then enumerated with a short description, etc, viz. *Morus bombycis* KOIDZUMI and its 11 varieties, of which almost all are new varieties of the author.

**367. Some experiments concerning the development of yellow mosaic disease (white streak) of wheat.** (Japanese). Suehiko IKATA and Iitirō KAWAI.—**Relation between the development of yellow mosaic disease of wheat and soil temperature.** (Japanese). By the same authors. (Jour. Plant Protect. **24**, 1937, 491–501, 847–854).

The author's experiments of yellow mosaic disease of wheat (white streak) have shown that here the virus invades always through the roots and root-crowns of the host, and never through the overground parts. This subterranean infection takes place chiefly in the soil depth of  $\pm 3$  cm and never in that more than  $\pm 15$  cm. It was further ascertained that when the infested soil particles, to which a certain quantity of water is added, is filtered out through the filter paper, the filtrate is unable to cause the development of the disease. An experiment specially done by the use of a soil thermostat for determining the relation between the development of the disease and the soil temperature has shown that the optimum for it is  $\pm 15^\circ$ ; next comes  $10^\circ$ , while at  $20^\circ$  slight effect and, at  $25^\circ$  none is perceptible.

Besides, frame- and field experiments were performed to confirm the results above indicated.

**368. Zur Kenntnis des Erbverhaltens einer gynodiözischen Pflanze, *Petasites japonicus* MIQ.** Seitirō IKENO. (Cytologia, FUJII Jub. Bd., 1937, 888-896, 2 Textfig.).

Bei *Petasites japonicus* findet man zwei Sorten Individuen, nämlich, zwittrige und weibliche, woher diese Pflanze als eine gynodiözische zu betrachten ist. Die zwittrige Sorte, wobei die männlichen und die weiblichen Organe zumindest äusserlich ganz gesund zu sein scheinen, erweist sich ganz unfruchtbar, entweder durch Selbst- oder Fremdbestäubung, während die weibliche, wenn sie durch den Pollen des Zwitters behandelt wird, eine reichliche Menge von Achänen produziert. Aus den letzteren gehen beide zwittrige und weibliche Stöcke in fast gleicher Zahl hervor. *Petasites japonicus* steht somit im Gegensatz zu früher von CORRENS genau untersuchten *Satureia hortensis*, wobei die zwittrige Stöcke die zwittrigen und die weiblichen die weiblichen Nachkommen erzeugen. Die morphologisch zwittrigen Stöcke von *Petasites* ist daher physiologisch männlich und somit gleicht unsere Pflanze physiologisch einer diözischen. Wenn man nach der üblichen Meinung verschiedener Autoren die unisexuellen Pflanzen phylogenetisch aus den zwittrigen angekommen betrachten wird, so ist unsere Pflanze als eine Uebergangsstufe vom zwittrigen zum diözischen Zustand zu betrachten, welche einen Schritt weiter nach der reinen Diözie als *Satureia hortensis* fortgeschritten ist. Inbezug auf einigen anderen im vorliegenden Aufsatz enthaltenen Angaben sei auf das Original verwiesen.

**369. On an edible Mongolian fungus "Pai-mo-ku".** Sanshi IMAI. (Proc. Imp. Acad. 13, 1937, 280-282, 1 text-fig.).

"Pai-mo-ku" or "Bai-mo-ku" is an edible mushroom growing in Mongolia which is highly esteemed by the Mongolians, Manchurians and Chinese. Basing on its dried specimens got by the author as well as the description of fresh materials by Mr. AKAISHI in South Manchuria, the author considers it as a new species, *Tricholoma mongolicum* and describes it in detail. *Nemocomyces mongolicus* gen. nov. et sp. nov., recently announced by PILAT seems to be closely allied to the author's fungus.

**370. The behavior of the plastid as a hereditary unit: the theory of the plastogene.** Yoshitaka IMAI. (Cytologia, FUJII Jub. Vol. 1937, 934-947, 8 text-figs.).

The plastid often changes its character owing to mutation, so-called plastid mutation. The mutated plastid is frequently constant, and transmitted as such from cell to cell and from generation to generation. The author thinks that the "plastogene" may be contained in the plastid which determines its character, in the manner just comparable to the gene contained in the chromosome. Some instances

of variegated forms are described with illustrations to elucidate the author's theory of the "plastogene".

**371. Über experimentell erzielte Missbildungen des Spaltöffnungsapparates bei *Iris japonica* THUNB.** (M. japan. Zfg.). Shun-ichiro IMAMURA und Jiro YOSIMATU. (Bot. Mag. Tōkyō **51**, 1937, 742-750, 1 Taf.).

Der Inhalt des vorliegenden Aufsatzes ist schon früher teilweise veröffentlicht worden (vgl. diesen JOURNAL **6**, (3), Nr. 12). Das unifaziale Blatt von *Iris japonica* ist im Gegensatz zum Schwertblatt von anderen *Iris*-arten nach dem Boden geneigt, wobei seine Unterseite ausschliesslich die Spaltöffnungen trägt, während seine Oberseite davon frei ist, und statt denselben die sog. "Kurzzellen" erkennen lässt. Die letzteren sind kürzer als die Epidermiszellen und offenbar als die Hemmungsbildungen des Spaltöffnungsapparates aufzufassen. Die nach der Blattspitze immer neu ausgebildeten Mutterzellen der Schliesszellen werden sich nach der Richtung der einwirkenden Schwerkraft entweder zu Spaltöffnungen oder Kurzzellen entwickeln, d.h. zu den ersten an der Unter- und zu den letzteren an der Oberseite. Kehrt man die Pflanze um, um die bisherige Unter- und Oberseite des wachsenden Blattes zur neuen Ober- und Unterseite auszumachen, so kann man es zur Umkehrung seiner Dorsiventralität zwingen, indem bei solchen Blatt wegen der Entwicklungsfolge auf einer Blattseite die Spitze morphologisch als Oberseite und die Basis als Unterseite gestaltet wird, während auf der anderen Seite es sich gerade umgekehrt verhält. Daher sind z. B. an der Spitze nur die Spaltöffnungen und an der Basis nur die Kurzzellen vertreten oder umgekehrt, sodass wenn man die Pflanze alle 24 Stunden wiederholt umkehrt, so bekommt man ein Blatt, welches merkwürdigerweise an beiden Seiten bloss die Kurzzellen und gar keine Spaltöffnungen aufweist. Zwischen der Spitze und Basis des umgekehrten Blattes befindet sich die Uebergangszone, wobei man neben Spaltöffnungen und Kurzzellen viele Sorten Missbildungen wahrnimmt, z. B. die Spaltöffnungen, von denen nur eine Zelle als Schliesszelle ausgestaltet ist, oder dieselben, welche zum Blattlängsachse schräg oder senkrecht gerichtet sind usw. Eine Anzahl solcher Missbildungen sind in der zugefügten Tafel hervorgehoben.

**372. On the relationship between the quantity of chromosome and the size of nuclei and cells in various species of *Lycoris*.** (Japanese). Sukeo INARIYAMA. (Rpt. Japan. Soc. Advanc. Sc. **10**, 1934, 432-436).

Since various species of the genus *Lycoris* (*sanguinea*, *albiflora*, *radiata*, *aurea*, *squamigera*) are distinguished by the variety of the chromosome number the author has used materials for studying the relationship between the chromosome quantity and the size of cells ("Kernplasmarelation"). In the species examined by him the chromosome is either rod- or V-shaped (cf. the next No.). The author has measured the length of rod and that of each arm of V, V being considered to be a compound of two arms or rods. Since the breadth of the chromosome is nearly equal in all it was disregarded in the measurement. The quantity of the chromosome was calculated by the formula, long diam.  $\times$  short diam.  $\times \frac{\pi}{6}$  or diam.<sup>3</sup>  $\times \frac{\pi}{6}$  (the latter in PMC where the chromosome is almost spherical in diakinesis stage). The comparison of the chromosome quantity thus calculated and the size of cells has shown first of all that the size of PMC on one hand and its nucleus and also that of pollen cell on the other are approximately proportional to the quantity of chromosome, but not necessarily to its number. Since in palisade-cells and guard-cells of leaves the above relation was found not to exist necessarily, the author thinks that this relation

is seen in reproductive cells which have no adaptative power towards external influences, but not in vegetative ones which are provided with such power.

**373. Karyotype studies in Amaryllidaceae.** Sukeo INARIYAMA. (Sc. Rpts. Tokyo Bunrika Daigaku, Sec. B, No. 52, 1937, 59-113, 4 pls. and 3 text-fig.-groups).

The author's karyotype studies reported in the paper above cited refer to 15 genera and 39 species belonging to the family Amaryllidaceae. According to the results of his investigations the diploid chromosome number in this family lies between 12 and 150, and in about 20 species the basic number was found to be 11. The chromosomes are various in their size, viz, large, small and medium. In *Agave* and *Fourcroya* the basic chromosome complement consists of 5 very long and 25 very short chromosomes. In others the chromosome is rod- or V-shaped. Among the genus *Lycoris*, *L. sanguinea* contains 22, and *L. radiata* 33 somatic chromosomes, of which all are rod-shaped; the basic number is then 11, and  $22 = 2 \times 11$  (diploid),  $33 = 3 \times 11$  (triploid). *L. albiflora* contains 12 rod-shaped and 5 V-shaped chromosomes. Since the author considers here each V-shaped chromosome as a compound of two rod-shaped ones, 12 rods + 5 V-shaped correspond to  $12 + 5 \times 2 = 22$  rods. *L. straminea* contains 10 rods and 6 V =  $10 + 6 \times 2 = 22$ ; *L. squamigera* contains 21 rods + 10 Vs =  $21 + 10 \times 2 = 33$ , etc. etc. (Cf. this JOURNAL 7, (39), No. 146).

**374. A comparative study of rhizoid formation in the embryo development of fucaceous plants.** (Japanese). Shumpei INOH. (Bot. & Zool. 5, 1937, 1283-1288, 1 text-fig.-group).

In the Fucaceae the eggs liberated out from the conceptacle are either spheroidal or ellipsoidal, and measure variously. After the fecundation any egg becomes ellipsoidal, and is divided by a septum wall perpendicular to the longer axis. At the basal part of the young plantlet thus formed a small lens-shaped cell is cut off, viz. the rhizoid initial cell. The latter is divided into several cells, from each of which one rhizoid issues out. Since the number of the rhizoid cells is proportional to the size of the egg it follows that the larger the egg of any species the more numerous the rhizoids which will come out from it. To cite, for instance, two extreme cases, in *Fucus evanescens*, where the spheroidal egg cell measures  $60 \mu$ , only one rhizoid is developed, while in *Sargassum sisymbryoides* where the ellipsoidal egg cell measures  $321 \times 229 \mu$ , as many as 32 rhizoids will come out. The author gives a table indicating the size of the egg and the number of rhizoids in a large number of Fucaceae (*Fucus*, *Polvetia*, *Cystoseira*, *Turbinaria*, *Hizikia*, *Coccophora*, *Sargassum*) according to the results of investigation by various authors incl. the present author himself. In this table we see that the number of rhizoid cells varies in various species according to the geometric progression series 2: 4: 8: 16; 32.

Basing on the facts above mentioned the author comes to the conclusion that in general the more complex the organization of the species, the greater the number of rhizoids developed in each.

**375. Embryological studies on Turbinaria.** (Japanese). Shumpei INOH. (Bot. & Zool. 5, 1937, 1480-1484, 4 text-figs.).

In *Turbinaria ornata* and *filiformis*, both of which are dioecious, the eggs liberated out from the conceptacle remain adhering to the outer surface of the receptacle by means of the gelatinous substance. In the egg eight nuclei are formed by successive



nuclear divisions, of which seven degenerate and one remains to develop further. The egg cell is divided into two parts, upper and lower, and then by means of a septum wall a small lens-shaped cell is cut off at the extreme end which is the initial of the rhizoid. Through three successive divisions the latter is divided into eight irregularly arranged small cells, from each of which one rhizoid develops out as to form together a primary rhizoid system. This mode of development is in accord with what we see in *Hizikia fusiforme*, *Sargassum confusum* and *hemiphylla*.

**376. An embryological study on *Cystophyllum crassipes* J. AC.** (Japanese). Shunpei INOH. (Bot. & Zool. **5**, 1937, 1821-1829, 1 pl. and 4 text-figs.).

The egg liberated out from the conceptacle remains adhering to the outer surface of the receptacle by means of a certain gelatinous substance. In the fertilized egg the author has seen one nucleus, in which during the metaphase of its mitosis 64 rod-shaped chromosomes were discernible. The centrosomes were seen in certain stages. Through three successive divisions the young plant comes to consist of three cells, upper, middle and lower. The latter produces then in general through two successive divisions four cells, from each of which one rhizoid will come out. Exceptionally only one cell-division ensues, so that only three rhizoids are seen; in another case each rhizoid bifurcates, and the system seems apparently to consist of eight rhizoid cells.

**377. Materials for the Japanese dendrology I.** (Japanese with Latin diagnoses). Taizo INOKUMA and Yasuichi MOMIYAMA. (Bull. Tokyo Imp. Univ. Forests **25**, 1929, 3 pls. and 3 text-figs.).

Besides some new varieties and forms, etc. *Alnus Nagurae* sp. nov. is recorded with illustrations. All plants contained in this paper are provided with Latin diagnoses.

**378. Studies on the nodule bacteria X.** (Japanese). ARAO ITANO and AKIRA MATSUMURA. (Agric. Studies **28**, 1937, 267-296).

Experiments were performed on the root-nodule bacteria of *Astragalus sinensis* (three strains called A, B and C), soy bean and clover to learn the effect of some alkaloids and non-alkaloids on their growth as well as the formation of their involution forms. The addition of yeast extract to the nutrient medium is beneficial to the bacterial growth, but that of alkaloids is generally rather injurious than beneficial. The addition of guanidine, morphine hydrochloride, anthraquinone are more or less favourable, that of pyridine, strychnine are less so, and that of chinoline, chinine and brucine is injurious. The addition of alkaloids gives rise to various kinds of involution forms, rod-shaped, spherical, ellipsoidal, bifurcate, ramified, etc.

On the whole it may be said that though the alkaloids employed have almost no effect in promoting the bacterial growth, they have that of forming involution forms.

**379. Fungi of the Bonin Islands I II.** (With Japan. résumé). Seiya ITO and Sanshi IMAI. (Trans. Sapporo Nat. Hist. Soc. **15**, 1937, 1-12, 3 text-figs., 52-59).

Hitherto only a few fungi have been known from the Bonin Islands. The authors have visited them in 1936 for the purpose of studying there the fungi, of which about 300 species were collected. Among these collections the following are new and described: *Geastrum mirabile* Ed. FISCH., forma *chichishimae* f. nov., *Cyathus boninensis* sp. nov., *Hysterogium hahashimense* sp. nov., *Rhizopogon boninensis* sp. nov., *Clavaria*



*boninensis* sp. nov., *C. subargillacea* sp. nov., *C. subacuta* sp. nov., *Phillipsia institia* sp. nov., *Boedijnopeziza* (gen. nov.) *institia* sp. nov.

**380. Filices japonenses VI-VII.** (With Japan. résumé). Hirosi ITÔ. (Bot. Mag. Tôkyô **51**, 1937, 709-714, 9 text-figs.; 725-730, 771-773).

In this paper some species of the genus *Cyclosorus* are enumerated, for which a key for identification is given.

**381. Saisonwechsel des osmotischen Wertes bei den Pflanzenzellen.** (Japanisch). Tadao JIMBO. (Oekolog. Studien **2**, 1936, 231-234, 2 Textfig.).

Der jeden Tag wiederholende stündliche Wechsel des osmotischen Wertes der Pflanzenzellen sowie der jährliche Saisonwechsel desselben bei den immergrünen Pflanzen sind die wohl bekannte Tatsache. Der Verf. hat bei den Oberhautzellen der Laubblätter von *Fatsia japonica* und *Ilex latifolia* sowohl den osmotischen Wert als die darin enthaltene Menge von Wasser, Zucker und Stärke an den sukzessiven Monaten eines Jahres bestimmt. Dabei wurde der osmotische Wert nach der grenzplasmolytischen Methode gemessen. Es wurde gefunden, dass der osmotische Wert sowie die Menge von Mono- und Disacchariden grösser im Winter als im Sommer sind, und auch dass es sich bei der Menge von Wasser und Stärke gerade umgekehrt verhält. Es ist leicht begreiflich, dass der höhere osmotische Wert der Laubblattzellen im Winter der höheren Menge der darin enthaltenen osmotisch wirksamen Substanzen zu verdanken ist. Der höhere Wassergehalt macht die Konzentration des Zellsaftes niedriger, was den niederen osmotischen Wert im Sommer erklärt. Es ist auch ganz klar, dass die Umkehrbarkeit des Umwandlungsvorganges der osmotisch unwirksamen Stärke zum dabei wirksamen Zucker zum Saisonwechsel des osmotischen Wertes beiträgt.

**382. Chromosome chimeras and polyploidy in *Solanum gracile* Link.** Fuyuwu KAGAWA. (Cytologia, FUJII Jub. Vol., 1937, 733-744).

This paper is partly a detailed description of another formerly written in Japanese and abstracted in this JOURNAL **9**, (7), No. 37. The fact is added that the author has got besides di- and tetraploids some triploids by crossing an individual which is supposed to be a true tetraploid  $\times$  a diploid. Its behaviour in meiosis of PMC is announced.

**383. On a large-grained sterile strain of rice-plant and the inheritance of its chimera.** Fuyuwu KAGAWA. (Proc. Crop Sc. Soc. Japan **9**, 1937, 319-340, 2 text-figs. and 8 tables).

In the autumn 1934 six completely sterile rice-plants bearing large grains have appeared among the strain known by the Japanese name "Urasan". The author has isolated carefully several tillers of each mutant stock, and cultivated them in pots separately in a glass-house. In the spring and autumn of the next year (1935), though generally they have shown the mutant character few of them were wholly identical to the original normal "Urasan" strain. Since all of them have been derived from the original mutant stock in the vegetative way (tillering) the production of normal strain denotes that in a certain portion of the mutant body the character of the normal strain has appeared in the chimerical way. It is to be noticed that though the plants showing the mutant character above quoted remained quite unchanged in the next year, many of them have borne besides sterile large grains few normal fertile ones, thus making such plants semi-sterile instead of completely sterile.

All normal plants just cited were submitted to natural pollination, and the offspring of the next generation were examined. The offspring produced by each of them were either all normal or in the ratio of 3 normal: 1 sterile. If we denote the normal plant by AA and the mutant by aa, the parents of such offspring should be either AA or Aa. Some normal plants were found to produce besides the normals a very few steriles, for instance, 712 normals and 8 steriles. The author thinks that in this case the number of steriles is too small for considering the parent stock as Aa, and consequently he is led to the hypothesis that this should be due to the occurrence of some few mutations  $A \rightarrow a$  in the AA-stock.

**384. Untersuchungen über die Wirkung des elektrischen Stromes auf lebende Zellen. I. Das Verhalten der mitotischen Figur unter Wirkung des Gleichstromes.** Noburô KAMIYA. (Cytologia, FUJII Jub. Bd., 1937, 1036-1042, 1 Textfig.).

Der Verf. hat die Einwirkung des elektrischen Gleichstromes auf die lebenden Haarzellen von *Tradescantia reflexa* untersucht. Wenn ein starker Strom (0,2–1,0 mA) nur kurze Zeit einwirkt, so sieht man die Bewegung der ganzen Spindelfigur nach der Anode, und beim Stromunterbrechen kehrt sie bald zur Anfangsstelle zurück. Dabei findet gar keine relative Bewegung zwischen den Chromosomen und der sie umgebenden Spindelsubstanz statt. Beim Uebertritt der Stromintensität oder der Wirkungsdauer erfolgt die Gelifizierung des Cytoplasmas, wobei keine Rückbewegung der Spindelfigur mehr geschehen kann. Bei der Einwirkung des schwachen Stromes (0,001–0,05 mA) ist keine sofortige morphologische Reaktion zu sehen, doch bei langdauernder Strömung sieht man eine beträchtliche Hemmung des Teilungsvorganges. Keine nennenswerte Verschiebung der Teilungsfigur, wie es bei der Einwirkung des starken Stromes der Fall ist, erfolgt, doch verschiebt sich die Scheidewandanlage bald nach der anodischen, bald nach der kathodischen Seite.

Nach der Verf.s Meinung ist die oben erwähnte Bewegung der Spindelfigur nicht als die Elektrophorese der Chromosomen aufzufassen, sondern vielmehr mag sie auf verschiedene polarisatorische Veränderungen des Cytoplasmas beruhen.

**385. New or noteworthy trees from Micronesia XIX.** (With Japan. résumé). Ryôzô KANEHIRA. (Bot. Mag. Tôkyô 51, 1937, 906-913, 8 text-figs., 939-940).

The following are recorded as new species: *Pandanus kusaicolus*, *Sterculia ponapensis*, and *Eugenia Bryanii*.

**386. Über ein neues mechanisches Gewebe in den Blättern der Cornus-Arten.** (M. japan. Zfg.). Riukiti KANO. (Bot. Mag. Tôkyô 51, 1937, 926-930, 1 Textfig. und 1 Taf., 942).

Es ist wohl bekannt, dass die Bastfasern und Kollenchymzellen oft im Blattrand in Form eines Stranges vorhanden sind, um als mechanisches Gewebe zu dienen. Bei zwei Arten von *Cornus*, nämlich *kousa* und *florida*, entdeckte der Verf. den bisher niemals beobachteten mechanischen Strang, welchen er Helicenchym nennt. Die Elemente desselben sind prosenchymatisch und mit zwei oder drei spiraligen Verdickungsleisten versehen, welche sich mächtig entwickeln und sich sehr dicht winden. Der hauptsächlichste Unterschied dieser Elemente aus den gewöhnlichen Spiralgefäßen besteht darin, dass die Verdickungsleisten der ersteren nicht verholzt sind, ähnlich den Kollenchymzellen. Das Helicenchym kommt als ein Strang vor, durchzieht den ganzen Blattrand und streckt sich basipetal in die Kante des Blattstieles hinein.

**387. On the relation of atmospheric humidity to the infection of the rice-plant by *Ophiobolus Miyabeanus* Ito et KURIBAYASHI and to the germination of its conidia.** (Japanese with English résumé). KIICHI KATSURA. (Ann. Phytopathol. Soc. Japan 7, 1937, 105-124).

After the drops of conidial suspension of *Ophiobolus Miyabeanus* sprayed down on rice seedlings had dried, the latter were placed under various constant relative humidities made by using  $H_2SO_4$  of different concentrations. When seedlings were kept at 92-100% relative humidity they showed typical lesions of the disease after 5 days, while kept at 89% during the same duration they remained quite free from such lesions.

The conidia kept on the slide kept at 92% r.h. were found to germinate only slightly, and those kept at 89% to germinate not at all.

As will be seen from the above statements the limits of the relative humidity in which the disease occurs correspond to those of the germination of conidia on the slide-glasses, wherefrom it may be inferred that the lack of infection under low relative humidity is due to the inability of the conidia germination under such humidity.

**388. The Japanese puff-ball.** (Japanese with English résumé). SEIITI KAWAMURA. (Jour. Japan. Bot. 13, 1937, 748-757, 7 text-figs.).

The Japanese giant puff-ball was identified at first to *Calvatia maxima* (SCHAEFF.) MORC. and later to *Lasiosphaera Fenzlii* REICH. by LLOYD. Comparative examination has convinced the author of the fact that such identification is not right, whereupon a new name *Calvatia nipponica* is proposed.

**389. Possibility of crossing-over between semihomologous chromosomes from two different genomes.** HITOSHI KIHARA and ICHIZO NISHIYAMA. (Cytologia, FUJII Jub. Vol., 1937, 654-666, 11 text-figs. and 1 diagram).

The cytological investigation was made on the genus hybrid, *Triticum polonicum* (AB,  $n=14$ )  $\times$  *Haynaldia villosa* (V,  $n=7$ ), and its back-cross progenies. In the first maturation division of PMCs in the  $F_1$ , bivalent chromosomes are very weakly associated, and their numbers vary from 0 to 4, 0-1 bivalent being most frequently found. Accordingly the maturation division proceeds very irregularly. It is especially noted that complete or incomplete regressions are occasionally observed, resulting in the production of gametes with 20-22 chromosomes. From the cytological study on back-cross  $F_1$ , ( $F_1 \times$  wheat) it was proved that the functional female gametes of  $F_1$  had mostly 21 chromosomes (ABV). Back-cross plants having 35 chromosomes (AABBV) usually showed  $14_{II} + 7_I$ . But certain unexpected modifications of chromosome pairing were occasionally found in a few individuals. The cause of these modifications was discussed at length. Certain cases are readily understood by an assumption of crossing-over between semihomologous chromosomes from A (or B) and V.

So far as the change of chromosome number in the offspring of plants with AABBV is concerned its process is similar to that of pentaploid wheat hybrids (KIHARA 1924).

NISHIYAMA.

**390. Studies on the wilt-resistant strains of flax. IV.** (Japanese). MUNEO KIKUCHI. (Proc. Crop Sc. Soc. Japan 9, 1937, 288-307, 1 graph and 11 tables).

Studies concerning the resistance of flax strains against wilt disease were first of all done on those which the author calls OR and MR respectively. Of these two

strains the former is highly susceptible to the disease, while the latter is very resistant against it, though not quite immune. The crossing between these two strains were performed, and the two parents as well as the  $F_1$  offspring were cultivated in infested soil under similar conditions and at the temperature 16–20°C. To cite some numerical examples from the results of these culture experiments it was found, for instance, after 4 weeks that the percentage of infection was (in round number) 10, 90, 19, and 21 in MR, OR,  $MR \times OR F_1$ , and  $OR \times OR F_1$  respectively. Thus the infection percentage in the  $F_1$  plants is considerably smaller than the average of that of the two parents. By means of self-fertilization of several  $F_1$  plants  $MR \times OR$  as well as  $OR \times MR$  a great number of  $F_2$ -families were got, which were cultivated together with the two parents, just in the same way as in the case of  $F_1$  plants. The infection percentage was seen to be very manifold, and though it is rarely pretty high in some families, in their greater majority it is lower than the average of that in the two parents, which shows that the hereditary power of resistance against the wilt is very intense. When we look at such a manifold variety of infection percentage, a series of gradations are found between the lowest and the highest, so that by distinguishing all gradations into a certain number of classes the author has made a graph, where the abscissa indicates the infection percentage, and the ordinate the number of  $F_2$  families corresponding to each class just mentioned, and it was seen that this graph is the normal curve.

It may be said also that the action of heredity is subjected to the influence of external conditions—phenotypic modification of the genotypic resistance power.

**391. Symbolae iteologicae III-IV.** Arika KIMURA. (Sc. Rpts. Tôhoku Imp. Univ. V. Ser. 12, 1937, 97–113, 5 pls. and 9 text-figs., 311–321, 3 pls. and 3 text-figs.).

The following new hybrids of *Salix*, etc. are described with illustrations:  $\times$  *Salix cremnophila* (= *S. gracilistyla*  $\times$  *S. japonica*), *S. Isikawae* (?*S. sachalinensis*  $\times$  *S. alopochoa*), *S. sirakawuensis* (= *S. futura*  $\times$  *S. integra*), *Toisochosenia Tatewakii* (= *Chosenia bracteosa*  $\times$  *Toisusu cardiophylla*), *S. Iwahisana* (= *S. gracilistyla*  $\times$  *S. Lackschenwitzuana*).

Many other species of *Salix* are enumerated or described.

**392. Conspectus omnium specierum generis Hyperici (excl. Sec. Asyron) in Yezo, Sachalin et Kuriles I-II.** (With Japan. résumé). Yojiro KIMURA. (Bot. Mag. Tôkyô 51, 1937, 700–708, 730–738, 27 text-figs., 773–774).

This paper begins with an artificial key for the determination of the species there described. The following species and varieties, *Hypericum kamschaticum* LEDEBOUR var. *hondoensis*, var. *Tatewakii*, var. *pibairense*, *H. Yamamotoi* sp. nov., var. *montanum* are contained. All species contained in this paper are described.

**393. Miscellaneous notes on Apiaceae (Umbelliferar) of Japan and Manchuria I-II.** (Japanese with Latin diagnoses). Masao KITAGAWA. (Bot. Mag. Tôkyô 51, 1937, 653–659, 805–812, 3 text-figs.).

The following plants are described with illustrations: *Ptermigopleurum* (gen. nov.) *neurophyllum* (MAX.) comb. nov., *Dystaenia* (gen. nov.) *ibukiensis* comb. nov., and *takesimana* comb. nov., *Homopteryx* (gen. nov.) *Nakaiana* sp. nov.

**394. Les Senecio du Japon.** (En japonais avec les diagnoses latines). Siro KITAMURA. (Acta Phytotax. et Geobot. 6, 1937, 265–275).



En tout 20 espèces japonaises du genre *Senecio* sont énumérées, dont *S. birubonensis* est nouveau.

**395. On the gelatinous cup-fungi, Bulgaria-group.** (Japanese). Yosio KOBAYASI, (Jour. Japan. Bot. **13**, 1937, 510-520, 10 text-figs.).

The author has distinguished according to BOUBIER two suborders of the Pezizales, viz. 1. Inoperculatae and 2. Operculatae. The first contains the genera *Bulgaria* FR. and *Coryne* TULASNE, while the second contains a family Sarcosomaceae newly established by the author with the genera *Sarcosoma* CASP. and *Neobulgaria* PETRAK. Several species and varieties contained in each of the genera above cited are enumerated or described with illustrations.

**396. Pacific region as the center of distribution of Gasteromycetes.** (Japanese). Yosio KOBAYASI. (Jour. Japan. Bot. **13**, 1937, 804-808).

The consideration of the distribution of several forms of Gasteromycetes, which is impossible to be referred to in this short abstract, leads the author to the general conclusion that the pacific regions (Australia, various islands in the Pacific Ocean and circumpacific regions), and especially those surrounding the Malay Isl. and New Guinea should be regarded as the center of their distribution.

**397. Phymatomyces, a new genus of the Tuberaceae.** Yosio KOBAYASI. (Jour. Japan. Bot. **13**, 1937, 912-914, 2 text-figs.).

*Phymatomyces* (gen. nov.) with *P. yezo-montana* sp. nov. is described. It is found in Mt. Daisetuzan in Hokkaidô on the crumbled soil, being seemingly hypogaeous.

**398. Fungi austrio-japoniae et micronesiae. I-II.** (With Japanese résumé). Yosio KOBAYASI. (Bot. Mag. Tôkyô **51**, 1937, 749-758, 776-778, 797-804, 826-828, 2 pls. and 8 text-figs.).

The following are recorded as new species and varieties: *Echinophallus Lauterbachii* P. HERM. var. *ponapensis* var. nov., *Boninogaster* gen. nov. (Melanogastraceae) with *B. phalloides* sp. nov., *Hymenogaster pacificus* sp. nov., *Cyathus badius* sp. nov.

**399. Contributiones ad cognitionem florum Asiae Orientalis.** Gen'iti KOIDZUMI. (Acta Phytotax. et Geobot. **6**, 1937, 210-223).

The following are recorded as new species: *Acer nambuana*, *Hypericum koshinense*, *Salix tambaensis*, *S. torrentis*, *Lonicera kinkiensis*, *Vaccinium santanense*, *Pyrus yohroensis*, *P. asakeensis*, *Cynanchum Matsudanum*, *Arundinaria cappatana*, *A. yenuensis*, *A. longifolia*, *A. minomarsa*, *Pleioblastus arundinarioides*, *P. Doykyanus*, *Sasa kammurensis*, *S. michinokuana*, *S. paludosa*, *S. permadescens*, *S. phymatonodosa*, *S. prodiosa*, *S. propinqua*, *S. Tashiroi*, *S. Tomookana*, *S. ureneiana*, *S. vulcanica*.

**400. Bambuseae novae japonicae V.** Gen'iti KOIDZUMI. (Acta Phytotax. et Geobot. **6**, 1937, 276-289).

The following are recorded as new species: *Arundinaria kariwaensis*, *A. koshinensis*, *A. praestantissima*, *A. yessoensis*, *Pleioblastus koshisimonii*, *P. epitrichus*, *Sasa aizuwensis*, *S. austrokurilensis*, *S. Chimakisasa*, *S. Hukudaeana*, *S. Iwabuchiana*, *S. kariwaensis*, *S. Koiyeana*, *S. macrospila*, *S. Muratana*, *S. perezugnoseta*, *S. persimilis*, *S. praeclosa*, *S. pseudonebulosa*, *S. queribunda*, *S. sacrariocola*, *S. sagraminensis*, *S. stereophylla*, *S. umbrosa*, *S. yessoensis*.



**401. Developmental history of the abnormal structure in the geophilous organ of *Aconitum*.** (With Japanese résumé). Masao KUMAZAWA. (Bot. Mag. Tôkyô **51**, 1937, 914-925, 1 pl. and 6 text-figs., 941).

Of the two sections of the genus *Aconitum*, viz. *Lycototum* and *Napellus*, the species belonging to the former are provided with the perennial erect rhizome which divides finally into several strands, while those of the latter are distinguished by having the biennial root-tuber. The latter is developed as follows: At the top of the mother-tuber some leaves and then an aerial stem sprout out in early spring; at the subterranean base of the radical leaf one axillary bud comes out, and an adventitious root is formed on it; the latter which is at first hardly distinguishable from the ordinary root grows out gradually into the root-tuber.

The author's present article refers to the development of abnormal thickening growth seen in *Aconitum mitakensis* belonging to the *Napellus* section. The root-tuber just mentioned exhibits the most remarkable abnormality, inasmuch as it has a very sinuous cambium and separate strands of cambium. In its adult stage the outermost part of the tuber consists of the endodermis, all parts outside it having been already destroyed. The development of this sinuous cambium is described as follows: In the earliest stage of development a circular zone of meristematic tissues is seen inside the primary phloem and outside the primary xylem; though at first no tangential rows of cells as seen in normal cambium do appear, yet soon some fragments of the tangential cambium begin to appear in this zone; these fragments come then into connection and develop finally into the sinuous cambium as seen in the adult tuber.

Hitherto the phylogenetic relationship between the section *Lycototum* and *Napellus* has been discussed by several authors, basing on the nature of the subterranean organ. But in these two sections its morphological nature is quite different, inasmuch as it is the rhizome in the one and the biennial root in the other, and furthermore, the development of the abnormal growth takes place in quite different manner. Therefore it will be not at all reasonable to base the phylogenetic discussion of the two sections on such organs of fundamentally different category.

**402. On the morphology and anatomy of *Achlys japonica* MAXIM.** (Japan. with English résumé). Masao KUMAZAWA. (Bot. Mag. Tôkyô **51**, 1937, 660-668, 5 text-figs.).

The results of the anatomical and morphological observations on *Achlys japonica* are described in this article, and compared to those of CITERNE's, TISCHLER's, and HIMMELBAUR's studies.

According to CITERNE and TISCHLER the scale-leaves of the rhizome in *A. triphylla* are arranged according to 2/5 divergence, but in *A. japonica* its arrangement is accurately of 1/2 type. Though according to HIMMELBAUR the xylem of the aerial stem is V-shaped, it is not so in the Japanese species. Here the cauline bundles in the rhizome are usually four, contrary to what has been observed by CITERNE (i.e. five, rarely four or six). According to the latter author the cortical bundles in the rhizome which originate from the trace bundles of the scale leaves do not unite into the cauline bundles, which is however the case in the Japanese species without any exception.

The vascular course in the aerial stem and the inflorescence axis have been traced by the author by means of serial microtome sections. According to these observations most of the large bundles situated in the part near the medullary portion of the aerial stem are cauline, but partly the trace bundles coming from the flowers

in the lower part of the inflorescence. The peripheral small bundles in the aerial stem are either the branches of the trace bundles coming from flowers or those of the cauline bundles.

The rhizome may be classified into two types in morphological sense, the one corresponding to the long and the other to the short shoot. The former has the long internode and elongates monopodially, while the latter has the short internode and elongates sympodially.

**403. Comparative studies on the vernalion in the Ranunculaceae and Berberidaceae.** (Japanese with English résumé). Masao KUMAZAWA. (Jour. Japan. Bot. 13, 1937, 573-586, 659-669, 713-726, 15 text-figs.).

This investigation was performed in order to know the fact what kind of factors has the influence on the type of vernalion, and further to what degree the latter may be significant in the phylogenetic sense. The general results obtained by the author are briefly referred to below. He has distinguished in all 11 types of vernalion in the Ranunculaceae and Berberidaceae, of which all, except *Diphylleia*- and *Podophyllum*-type, are of involute nature, and of neither revolute nor obvolvute. The vernalion in the first and the second leaves of the seedling does not necessarily correspond in respect to its type to that prevailing in the seminal leaves of each species. Basing on the type of vernalion in juvenile leaves and its development mode the author thinks that the so-called *Caltha*-type or *Achlys*-type represents the most primitive one, from which all other types might have been phylogenetically derived, except that in the *Podophyllum*- and *Diphylleia*-types which will belong to another line of evolution.

Though the nodding or erect petiole in the sprouting time is regarded as a stable character, the author could recognize no relation between this character and the vernalion. Nor have the anatomical character of the leaf and leaf-sheath, the cyclic or peltate nature of leaf-lamina, and the development order of leaf segments, etc. any influence at all on the vernalion.

In one and the same species the senior leaves show the same type of vernalion, except some few cases, where they are forced to show another type of vernalion under the influence of the space factor, which is consequently of no phylogenetic significance. Furthermore, different species belonging to one subgenus are similar in the vernalion type of their leaves, except *Anemone narcissiflora*. In different genera the vernalion type is not necessarily similar to each other.

The author comes to the final conclusion that in the Ranunculaceae and Berberidaceae the difference of vernalion type is due to the internal factor characteristic of each genus, and is consequently phylogenetically significant.

**404. Untersuchungen über die Geschlechtszellen von *Spirogonium stictum* KUTZ.** Seikan KUSUNOKI. (Cytologia, FUJII Jub. Bd. 1937, 850-856, 1 Taf. und 1 Textabb.).

Oft wurde bisher behauptet, dass bei *Sirogonium* (welches *Spirogyra* nahe verwandt ist und nicht selten unter der letzteren Gattung eingerechnet wird) der männliche Faden eine lange und eine kurze sterilbleibende Zelle und der weibliche nur eine einzige sterile Zelle aufweist, doch konnte der Verf. den dazu gerade umgekehrten Fall beobachten. Auch konnte er eine Form finden, wobei beide der männliche und weibliche Faden entweder nur je eine einzige sterile Zelle oder je zwei (lange und kurze) sterile Zellen besitzen. Woher es ganz klar ist, dass die obengenannten Merkmale den männlichen und weiblichen Faden keineswegs charakterisieren können. Oft

sieht man bei *Sirogonium* die Vorwölbungen der Fadenzellen, welche vielleicht als Ansätze zu Verbindungskanälen (wie bei *Spirogyra* wohl bekannt ist) zu deuten sind, und wahrscheinlich die Uebergänge zu *Spirogyra* darstellen mögen. Der Verf. konnte weder die kreuzweise noch die Seitenkopulation zur Anschauung bringen, doch kommt er zum Schluss, dass *Sirogonium* gemischtgeschlechtig sein soll, wenn dem Ref. warum nicht recht klar ist.

**405. Chiasma studies in *Allium fistulosum*, *Allium Cepa*, and their  $F_1$ ,  $F_2$  and backcross hybrids.** T. MAEDA. (Japan. Jour. Gen. **13**, 1937, 146-159).

In this paper, the results of observations on the mode of chiasma distribution in *Allium fistulosum*, *A. Cepa*, their  $F_1$  and  $F_2$  hybrids, and the backcross hybrid of the  $F_1$  to *fistulosum* are reported. In *Allium fistulosum*, all eight gemini were found in metaphase to have two localized chiasmata near the attachment point, while in *A. Cepa* and the  $F_1$  hybrid they have random chiasmata. In the  $F_2$  and the backcross hybrids, some definite gemini of the eight were found to have two localized chiasmata near the attachment point, and all the others random chiasmata. The numerical results obtained are given in some tables. It is concluded that these results on the mode of chiasma distribution are hardly explicable by the assumption of the genotypic control, or the action of a gene or a group of genes, proposed by DARLINGTON (1933) and LEVAN (1935, 1936). Author.

**406. Bacteriophage in relation to *Bacterium solanacearum*. II. Further studies on the phage and antiphagic serum.** Takashi MATSUMOTO and Norio OKABE. (Jour. Soc. Trop. Agric. **9**, 1937, 205-213).

Continuations of the paper published some time ago (cf. this JOURNAL **8**, (58), No. 250). The authors have made some experiments on the longevity of the bacteriophage for *Bacterium solanacearum* concerning the temperature, under which the culture of the phage is preserved. Thus, for instance, to cite few examples, the longevity under question was 30-70, 70-140, and 150-700 days at the temperature 37°, 31°, and 0° respectively. It was further found that this temperature relation does not change almost wholly in the presence of the homologous bacteria during the period of preservation. Furthermore, it was seen that the longevity of the phagic culture varies with different quality of potatoes used for the medium preparation. The degree of virulence of the phage will vary with the difference of the types of *Bacterium solanacearum*, of which the author has distinguished three, viz. "F" (fluidal form), "Op" (opalescent colony), and "C" (circular, light brown, concentric striate colony), of which the first is most resistant.

The neutralization of the phage by the antiphagic serum varies in its activity according to the difference of the phagic titre. To cite some instances, a complete neutralization occurred when the serum of the dilution 1:10 was kept for 2 hours at 38°, while in another case the same effect was obtained when the serum of the dilution 1:80 was kept under the same temperature. The neutralization activity of the serum is not impaired by heating to 50° for 1 hour, or even to 60-70°, but markedly so at 80° for 20 min. or 90° for 10 min.

**407. Miscellaneous note on the serological studies of the tobacco mosaic bearing malformed flowers.** (Japanese with English résumé). Takashi MATSUMOTO. (Reprinted from Agric. & Hortie. **12**, 1937, 5 pp. with 2 text-figs.).

The tobacco plant which produces peculiar malformed flowers was proven to suffer under the mosaic disease due to the virus complex which is the mixture of

tobacco and potato virus. To separate these two kinds of viruses from each other the author proceeded as follows. The juice of the diseased plant (1:3) was at first reacted against the antipotato mosaic serum in various concentrations, and after a certain procedure the supernatant fluid was inoculated into a healthy tobacco plant. When the serum concentration is 1:10, 1:30 or 1:60, the potato virus has completely disappeared, and besides the virulence of the remaining tobacco virus was not at all impaired, except in the case of 1:10. When the serum concentration is lower, the separation of the two viruses does not take place completely.

**408. Miscellaneous reports 4. Preliminary note on the bacteriophage for *Bacterium citri* (HASSE) DOIDGE.** (Japanese with English résumé). Takashi MATSUMOTO and Norio OKABE. (Agric. & Hortic. **12**, 1937, 2055-2059, 1 text-fig.).

The experiment of the authors consists in isolating the bacteriophage for *Bacterium citri*, the *Citrus* canker organism. It was isolated from the earth, where the infected plants are growing. It was found that this bacteriophage is able to attack *B. citri* only, and not any of 19 organisms experimented upon. The multiplication of the lytic principle seems to be maximum at 30° which is very nearly equal to the optimum temperature of the growth of the pathogen, 28-31°.

**409. Chromosome studies on *Trillium kamschaticum* PALL. III. The mode of chromatid disjunction at the first meiotic metaphase of the PMC.** Hajime MATSUURA. (Cytologia **8**, 1937, 142-177, 1 pl. and 24 text-figs.).

In the normal condition, the bivalents of *Trillium kamschaticum* take the cruciferous form, being paired at the kinetochore only and the occurrence of chiasmata is very rare. These features facilitate the study on the mode of chromatid disjunction at MI.

The present study was made by employing two different means: (i) by direct observations on the behavior of the paired kinetochores of metaphase bivalents, and (ii) by inferences from observations on the direction of chromonema coiling within pairs of half-bivalents at anaphase. The statistical results from these indicate that: (i) there are three cytological modes of chromatid disjunction for individual bivalents, (a) equational in both the arm pairs (EE), (b) equational in one arm pair but reductional in the other (ER), and (c) reductional in both the arm pairs (RR); (ii) the proportion of EE:ER:RR is 4:4:1 (actually 121:118:24 in the total 258 bivalents); and, (iii) for individual arm pairs, E:R = 2:1 (actually 464:225 in the total 689 arm pairs).

These results were explained by assuming (i) random assortment, two by two, of the four chromatids at diplotene, (ii) random assortment, two by two, of the four daughter kinetochores at metaphase, and (iii) independent occurrence of (i) from (ii).

Author.

**410. Chromosome studies on *Trillium kamschaticum* PALL. IV. Further studies on the direction of the chromonema within the first meiotic chromosomes.** Hajime MATSUURA. (Cytologia **8**, 1937, 178-194, 1 pl. and 4 text-figs.).

A statistical treatment on the subject matter indicated by the title has led to the following conclusions:

(i) The two arms of a chromosome behave independently in the spiralization of their chromonemata (the proportion of left-handed arms to right-handed ones being 1:1; actually 602:604),



(ii) the frequency of reversal in direction of coiling is a function of the length of the arms, with a certain reservation that it can occur usually only in chromonemata or more than a certain length, and

(iii) the chiasma bears no primary relation to the occurrence of changes in the coiling direction.

Author.

**411. Zytologische Untersuchungen der Bryophyten III. Die Morphologie des Spermatozoids von *Reboulia hemisphaerica*.** Tadamasa MIDUNO. (Cytologia FUJII Jub. Bd. 1937, 970-976, 12 Textfig.).

Der Spermatozoidkörper von *Reboulia hemisphaerica* besteht, wie bei demselben von anderen Arten, aus vier Teilen, nämlich, Kernstück, Zilie, Stammsubstanz und Plasmastück. Unter diesen ist das Kernstück der Hauptteil des Körpers; es ist hufeisen- oder sichelförmig, und beträgt im Mittel 10.38  $\mu$ , was das kleinste von den überhaupt vom Verf. bisher studierten Spermatozoiden der Lebermoose ist. Auch wurden einige noch kleinere missgebildete Kernstücke aufgefunden. Weiter sind einige Kernstücke gesehen, welche an ihren beiden Enden mehr oder minder gegabelt sind.

Das Plasmastück ist nicht immer zu sehen. Die Zilienzahl beträgt 2, selten 3.

**412. On the change of flora of Japan since the Upper Pliocene and the flora composition at the present.** Shigeru MIKI. (Japan. Jour. Bot. 9, 1938, 213-251, 2 pls. and 18 text-figs.).

**413. On the sexual reproduction of *Caulerpa*. (Prelim. note).** Kiichi MIYAKE and Hiroshi KUNIEDA. (Cytologia 8, 1937, 205-207, 11 text-figs.).

In *Caulerpa brachyrys* the gametes escape out from the burst tips of the papillae which are formed on the green surface of the frond. They are fusiform and more or less slenderly pear-shaped, and biciliate. The female gamete which is longer than the male has one red spot, while the male lacks it. Their conjugation and the consequent formation of the zygote were observed by the authors.

**414. Beeinflussung der Spaltöffnungsweite durch Regenfall.** Masami MONZI. (Japan. Jour. Bot. 9, 1937, 131-144, 3 Textfig.).

**415. Inheritance in rice, *Oryza sativa* L. II. Linkage between the gene for the purple plant colour and the gene for liguleless.** Toshitaro MORINAGA. (Japan. Jour. Bot. 9, 1938, 121-129).

**416. On the autopolyploids of the rape.** T. MORINAGA and H. KURIYAMA. (Cytologia, FUJII Jub. Vol. 1937, 967-969, 6 text-figs.).

Among a number of plants belonging to a common variety of the rape, *Brassica Napella* CHAIX. some plants were discovered, which are externally diploid though with some differences from the others. 2/3 of their pollen grains were abnormal in appearance, and seem to be functionless. In contrast to normal plants which possessed 19 bivalents in their PMC and where the meiosis of the latter goes on quite regularly, here in the heterotypic metaphase several univalents were seen; the latter usually lag behind in the anaphase. Diads were often developed.

From the seeds produced by them a number of the offspring have issued out. Among the latter three autotriploids and an individual which is presumably a tetraploid were found. The mode of irregular meiosis seen in their PMC is described.



**417. Culture of weeds VII. The effect of the reactions of nutrient solution on the alpine herbs.—VIII. The effect of yellow prussiate of potassium.—IX. The effect of Ca-ion on weeds in culture solutions.—X. On the correlations between Fe-ion and other cations.—XI. N-absorption as related to the weaker conditions.** (Japanese with English résumé). Keizi MORITA. (Ecolog. Studies 3, 1937, 10-12, 13-19, 117-124, 125-135, 239-248).

Ad VII.—Though the optimum pH-value for the growth of alpine herbs is naturally different in different plant species, yet the author's studies of their water-culture have indicated that in general these values lie between 2.8-6.0 in sun plants and 3.5-8 in shade ones. Further, the plants in the high moor were proved to be able to live in nutrient solution of wider amplitude of pH-value than rice-field plants. Also it is considered that the response of the alpine shade plants towards the pH-value of nutrient solutions resembles that of nitrate plants in the lower land.

Ad VIII.—By the addition of a certain quantity of  $K_4Fe(CN)_6$  to the nutrient solution of the culture some weeds are retarded in their growth, while others are promoted in this respect (for instance, *Alopecurus*, *Senecio*, *Miscanthus* belong to the former case, and *Cerastium*, *Vicia* to the latter). The author thinks that the poisonous effect of this substance on weeds is due to the cyan-ion, but not to Fe-ion.

Ad IX.—The reactions towards Ca-ion in the nutrient solution of water-culture are different in weeds of different habitats. The general rule is however that against Ca-ion the resistance is higher in plants inhabiting soils of higher acidity than those from those of lower acidity, and that also the requirement for the Ca-ion is lower in the former than in the latter. The resisting power against the Ca-ion as well as the requirement of various weeds is as follows in descending order: *Sphagnum*, *Polygonum*, *Alopecurus*, *Cerastium*, *Trigonotis*. In the so-called iron-plants the resistance against the action of the Ca-ion is high, and the requirement for it small. Strongly acid plants (e.g. *Sphagnum*, *Polygonum*, *Alopecurus*) are indifferent towards the Ca-ion, and sensitive towards the H-ion. while in lowly acid plants (*Cerastium*, *Trigonotis*) this relation is just the reverse.

Ad X.—The growth of *Alopecurus fulvus* may be retarded or promoted by the Fe-ion of the same concentration according to the concentration of the Ca- or Mn-ion present in the same nutrient solution and *vice versa*. The optimum combination of the Ca- and Fe-ions or the Mn- and Fe-ions for the growth of *Alopecurus* are  $Fe''' 20 \text{ ppm} + Mn'' 10 \text{ ppm} + Fe''' 15 \text{ ppm} + Ca'' 52 \text{ ppm}$ .

Ad XI.—A water-culture of *Alopecurus fulvus* was practised with  $NH_4Cl$  as the N-source. It was shown that the finer the weather, the greater the  $NH_4$ -absorption. Under the same weather condition young plants absorb the greater quantity of  $NH_4$  than less young ones. The hourly fluctuation of the  $NH_4$ -absorption tends to go parallel to that of the temperature, being larger in day- than in night-time.

**418. The effect of nitrogen supply on the growth of culms and roots.** (Japanese). Keizi MORITA. (Ecolog. Studies 3, 1927, 349-351).

In *Alopecurus fulvus* the optimum quantity of N for the best growth is different in culms and roots, the former requiring far much greater quantity of N than the latter. Roots may grow luxuriantly even by the supply of N in so small quantity as to lead to the bad growth of culms. The water content of leaves diminishes parallel to the decrease of the N-supply, while roots are very insensible in this respect.

**419. Widerstandsfähigkeit von Plankton gegen die Hitze.** (Japanisch). ISAO MOTOMURA. (Oekolog. Studien **3**, 1937, 167-168).

Gewisse Planktonorganismen eines kleinen Teiches in der Nähe des Moorbodens im botanischen Garten zum Hakkôdagebirge wurden als die Untersuchungsmaterialien benutzt. Sie wurden in das mit 5 cm Wasser gefüllten Probirglas hineingethan, und das ganze wurde in das mit Wasser gefüllten Becherglas gelegt. Das letztere wurde dann allmählich erwärmt mittels einer Alkohollampe. Bei einer gewissen Temperatur beginnen die Organismen am Boden des Probirglases unterzusinken, und bei dem weiteren Temperatursteigen wurden sie bewegungslos. Die Gradgrenze der Temperatur für dieses zweierlei Verhalten der Organismen sind natürlich nach ihrem Artunterschiede verschieden, so z.B. wie folgt (A = Grad des Untersinkens, B = Grad der Bewegungslosigkeit): *Scapholeberis mucronata* A = 41,3°, B = 40,0°, *Cyclops* sp. A = 37,5°, *Diaptomus pacificus* A = 38,8°, B = 36,9°, *Daphnia longispina* A = 37,1°, *Stentor* sp. A = 39,8°, B = 33,5°.

**420. Studies on the growth hormone of plants III. The occurrence of growth substance in isolated roots under sterilized conditions.** (Preliminary report). MASAYUKI NAGAO. (Sc. Rpts., Tôhoku Imp. Univ. IV. Ser. **12**, 1937, 191-193).

Whether the growth hormone is secreted by the root-tips or not is now under discussion by various authors (THIMAN and FRIEDLER on one side, and BOYSEN JENSEN and the author himself on the other). Some time ago the author has published his experimental result that in *Helianthus annuus* and some other plants the hormone is secreted by the root-tips (cf. this JOURNAL **8**, (67), No. 275). The present studies on *Helianthus annuus* were performed in order to confirm the results of his former experiments. Root-tips were cut off from young seedlings, and each of them was put in a test-tube containing a nutrient medium. The quantity of hormone secreted by the root-tip was determined according to the *Avena* curvature method of WENT. The curvature after six days was found to be 11.4-22.4°, so that it was concluded that so far as *Helianthus annuus* is concerned, a considerable amount of the growth hormone must be secreted by the root-tip.

**421. On the effect of sunlight upon the development of the helminthosporium disease of rice.** (Japanese with English résumé). NAKATO NAITO. (Ann. Phytopathol. Soc. Japan **7**, 1937, 1-13).

For the performance of experiments glass boxes were used, some of which were covered with black paper to prevent the entrance of sun-light. Plants artificially inoculated with conidia of *Ophiobolus Miyabeanus* were placed within these boxes and all were put under the same external conditions except the light intensity. It was found that first of all rice seedlings are more abundantly infected in the absence of light than in its presence. Furthermore, it was found that the number of diseased lesions per unit length of the leaf was minimum when inoculated seedlings were within the box covered with black paper and maximum within that covered with two sheets of cotton cloth. When the box is uncovered or covered with a single sheet of cotton cloth, that number was found to lie between these two extremes.

The germination of conidia takes place more profusely and the length growth of germ-tubes more vigorously in the absence of light than in its presence.

**422. Notulae ad plantas Asiae Orientalis (II)-(IV).** (Japanese with Latin diagnoses). TAKENOSHIN NAKAI. (Jour. Japan. Bot. **13**, 1937, 71-491, 557-569, 872-892, altogether 5 text-figs.).

The following are new plants: *Bupleurum jeholense*, *Abelia anhwsensis*, *A. Hersii*, (with an artificial key for the determination of all known species of *Abelia*), *Daphne koreana*, *Daphnimorpha* (gen. nov.).

**423. Japanese species of *Veratrum* (I)-(II).** (Latin and Japanese). Takenoshin NAKAI. (Jour. Japan. Bot. **13**, 1937, 631-645, 701-713).

The keys for the determination of the species contained in various subsections (some of which are newly established ones) are given. The following are recorded as new plants: *Veratrum sikokianum* and *sadoense*.

Lastly the key for the determination of the tribe Melanthaceae is given.

**424. Japanese species of *Rubus*.** (Japanese, Latin and English). Takenoshin NAKAI. (Jour. Japan. Bot. **13**, 1937, 779-783).

The East-Asiatic *Rubus cordifolia* does not correspond to the Linnean species; it has black berries instead of reds, so that the author calls it *R. Akane* sp. nov. *R. cordifolia* in PALLAS' Reise which is called *R. cordifolia* var. *pratensis* MAXIMOWICZ and *R. cordifolia* var. *sylvatica* MAXIMOWICZ are regarded to be independent species, *C. pratensis* sp. nov. and *C. sylvatica* sp. nov. respectively. The key for the determination of these and some other species is given.

**425. Iconographia plantarum Asiae Orientalis** Vol. II, Nos. 3-4. Takenoshin NAKAI. Tokyo 1937-1938, 141-168. 8 pls.; 169-192, 7 pls.

The following plants are described and illustrated: No. 3, *Arisaema angustifolium* NAKAI var. *serrulatifolium*, *integrifolium*, *holophyllum*, *A. siwoense* NAKAI, *A. peninsulae* NAKAI, *A. alpestre* NAKAI (all above by NAKAI), *Croomia kiusiana* MAKINO, *Chacmaegastrodia shikokiana* MAKINO et MAEKAWA (above two by MAEKAWA), *Clematis Williamsii* A. GRAY (by HARA).—No. 4, *Dryopteris microlepigera* NAKAI (by IRÔ), *Eriocaulon atrodes* SATAKE (by SATAKE), *Hetaeria Raymundi* SCHLECHTER, *Plantanthera boninensis* KOIDZUMI, *Stereosandra liukiuensis* TUYAMA (above three by TUYAMA), *Hypericum Asahinae* MAKINO var. *siroomenses* Y. KIMURA (by KIMURA), *Oldenlandia kiusiana* MAKINO (by HONDA).

Vol. II of *Iconographia* is now completed. The index for Japanese and scientific names terminates the volume.

**426. Cytological studies on the hybrid between *Triticum turgidum* and *Secale cereale*.** (Japanese with English résumé). Goichi NAKAJIMA. (Japan. Jour. Gen. **13**, 1937, 177-184, 23 text-figs.).

The  $F_1$  plant produced by the crossing *Triticum turgidum* ( $n=14$ )  $\varphi \times$  *Secale cereale*  $\sigma$ , in which the genom consists of 7 normal and 2 specially small chromosomes, contains 23 chromosomes, as will be expected. In the meiosis of PMC 0-5 bivalents and 13-23 univalents are observed. One specially small bivalent is often met with, which is apparently derived from the small chromosomes of *Secale*. The chromosome behaviour in the first and the second division is irregular. In one PMC 9 bivalents + 14 univalents were seen. The former have in all probability been produced by the doubling of the *Secale* chromosomes taking place in the archesporial cell.

**427. The growth-limiting effects of dwarf genes on some organs of rice.** (Japanese with English résumé). Kane NAKAYAMA. (Japan. Jour. Gen. **13**, 1937, 196-199, 2 text-figs.).

The author has received from Prof. AKEMINÉ in Hokkaidô University four kinds of rice-strain which are characterized by different genic formulae, viz. Akage AABB, Ebisu AAbb, Daikoku aaBB, and Kodaikoku aabb. The genes a and b are regarded as dwarf ones, so that the strain AABB is of normal size. Through the measurement of the length of stem, panicle, glume, etc. the author has studied the effect of such genes for preventing their growing out to normal size. Thus, to cite only one instance, the length (cm) of panicles was found in average to be 13.7, 11.5, 10, 6.8 in the strains AABB, AAbb, aaBB and aabb respectively. The measurement of floral organs (anther, stigma, ovary, pollen) as well as dormant embryo, coleoptile, and radicle has revealed the fact that these genes have no growth-limiting effect on them.

**428. Ecological studies of the vegetation of the Abukuma river basin.** (Japanese with English résumé). Kyôzi NAOHARA. (Ecolog. Studies **2**, 1936, 180-191, 306-318; **3**, 1937, 35-46, 12 text-figs. and 13 tables).

Abukuma is one of the great rivers in Northern Japan Proper. The destructive action of inundations occurs in its river basin usually once per year. The author distinguishes there three vegetation zones, viz. unstable, semi-stable and stable. The unstable zone, on account of inundations just mentioned, remains quite bare for the greater part of each year, though in the year when the inundation had not occurred or when only a slight destruction had taken place, few plants may grow there (for instance, some species of *Chenopodium*, *Polygonum*, *Cassia*, *Microlespedeza*). The adjoining semi-sterile zone which is less disturbed by the inundation than the unstable is characterized by the occurrence of some sand-resisting plants, as *Carex pumila* and *Imperata cylindrica* var. *Koenigii*, which form a sand plant community. Sand and humus piled up there by the flood lead to the further invasion of some other plants, which gradually build up a proper river bed plant community in the stable zone, where *Zoysia japonica* grows vigorously, and becomes finally the dominant plant. The mode of plant succession just spoken was further proven by the author by means of the scores of permanent chart quadrates and belt transects marked there. During this process of succession the contents of fine sand and igneous loss increase considerably, the pH of soil becomes lower, the Ca-content decreases, phosphate and nitrate increase, especially the latter, when leguminous plants will grow there.

**429. Additional note to the tetrapolarity of the hyphae in *Cortinellus Berkeleyana*.** (Japanese). Yosikazu NISIKADO and Tatuo HIGUTI. (Agric. Studies **28**, 1937, 431-439, 15 tables).

NISIKADO and one other author have jointly published formerly the results of their experiments concerning the fact that in *Cortinellus Berkeleyana* four sexual groups are distinguishable (cf. this JOURNAL **8**, (70), No. 286). The authors have got now the materials from various parts of Japan, and their experiments of monosporous cultures from 11 different individuals have confirmed perfectly the conclusion formerly drawn.

**430. Contributions to the moss flora of Japan and Formosa (VIII).** (With Japanese résumé). Akira NOGUCHI. (Jour. Japan. Bot. **13**, 1937, 784-794, 4 text-figs.-groups).

The mosses from Botel Tobago Isl. (Formosa) are enumerated or described, of which the following are new species: *Thamnum incurvum*, *Meteorium papillarioides*, *Haplophymenum spinosum*, *H. fasciculare*.



**431. Shoot drooping disease of *Acer trifidum* HOOK. et ARN. caused by *Pseudomonas acernea* n. sp.** (Japanese with English résumé). Takasi OGAWA. (Ann. Phytopathol. Soc. Japan **7**, 1937, 125-135, 4 text-figs.),

Recently a new disease of *Acer trifidum* which is much cultivated as avenue tree in Tôkyô has broken out. It is characterized by producing spots of water-soaked appearance on leaves, leading finally to their blackning and drying up.

The author's inoculation experiments of healthy leaves with the organisms from the diseased ones have given positive results, and shown that the causal organism of this shoot-drooping disease is an aerobic organism, *Pseudomonas acernea* sp. nov.. It is provided with one polar flagellum, its group number being Ps. 211.223032. It is able to infect not only *Acer trifidum*, but also many other species of the genus *Acer*.

**432. Anatomy and morphology of *Oleandra Wallichii* (HK.) PR., with some notes on the affinities of the genus *Oleandra*.** Yudzuru OGURA. (Japan. Jour. Bot. **9**, 1938, 193-211, 9 text-figs.)

**433. On the fertilization of *Nelumbo nucifera*.** Ichiro OHGA. (Cytologia, FUJII Jub. Vol., 1937, 1033-1035, 1 pl. and 4 text-figs.).

In *Nelumbo nucifera*, on the first day of its flowering and the morning of the next the embryo-sac which is already mature contains one egg-cell as well as one fused polar nucleus or two not yet fused polar nuclei; the synergids are then already degenerated. Fertilization is effected within about 6 to 8 hours after pollination, and one sperm-nucleus fuses with the large polar fusion nucleus, while the other fuses with the egg-nucleus. The division of the primary endosperm nucleus follows immediately. *Nelumbo nucifera* may therefore be considered as one instance where a very short time-interval intervenes between pollination and fertilization.

**434. Symbolae ad florae Asiae Orientalis 15.** (With Japan. résumé). Jisaburo OHWI. (Acta Phytotax. et Geobot. **6**, 1937, 145-153).

Among the plants enumerated by the author the following are new: *Stellaria linumae*, *Clematis okinawensis*, *Corydalis hondoensis*, *C. taiwanensis*, *Pedicularis Koidzumiana*, *Smilax Sarumame*, *Fritillaria Muraiana*.

**435. A new species, *Pedicularis Ishidoyana* KOIDZ. et OHWI sp. nov.** (Japanese with Latin diagnosis). Jisaburo OHWI. (Acta Phytotax. et Geobot. **6**, 1937, 291).

Found in the middle part of Corea.

**436. Studies on the variation of *Bacterium solanacearum*. (Preliminary report).** (Japanese with English résumé). Norio OKABE. (Ann. Phytopathol. Soc. Japan **7**, 1937, 95-104, 1 pl.).

The author could distinguish 16 types of *Bacterium solanacearum*, characterized by the nature of their respective colonies. All of them are able to lytic action of the bacteriophage specific for *B. solanacearum*.

**437. On the distribution of *Trichoderma* in Mt. Hakkôda.** (Japanese with English résumé). Yônosuke OKADA. (Ecolog. Studies **3**, 1937, 309-321).

The distribution of *Trichoderma* on various plant communities in Mt. Hakkôda was studied by streaking freshly exposed soil surface supposed to contain this organism directly on the agar plate. The distribution of *Trichoderma* was found to be variable in different plant communities, of which 9 types were studies, viz. Pseudo-



sasetum, Fagetum, Abietetum, Pinetum, detritus around the crater, bare land near solfatara, Cladonietum near solfatara, Sphagnetum and Narthecietum. The pH-value of such plant communities lies between 2.0-4.7. All of them contain more or less *Trichoderma*, except bare land near solfatara. The organism under discussion is found profusely in soil rich in raw humus, and poorly in water-logged soil. In the soil of Pseudosasetum *Trichoderma* exists mostly as spores, and was detected as deep as 40 cm.

**438. Karyological studies on some species of *Lobelia*.** Shun OKUNO. (Cytologia, FUJII Jub. Vol., 1937, 897-902, 22 text-figs.).

The basic chromosome number of the genus *Lobelia* was considered by some as 7 and by others as 8. The author has studied 7 species belonging to this genus, and could confirm the former view, and besides find a polyploid series  $2x-4x-6x$ . In *L. sessiliflora* the nucleolus divides into two at an early stage of somatic division. One of them is closely connected with a chromosome at its distal end, while the other has no connection at all with any one. It is noticeable that here no relationship was discernible between the nucleolus and the satellited chromosomes.

**439. On the karyotypes of *Paraixeris denticulatoplathphylla*. (A preliminary note).** (Japanese). Humihiko ONO. (Jour. Japan. Gen. **13**, 1937, 255).

*Paraixeris denticulatoplathphylla* which has been experimentally proved to be a hybrid between *Paraixeris denticulata* and *Crepidiastrum lanceolatum* var. *latifolia* (cf. this JOURNAL **8**, (72), No. 297) produced in  $F_2$  a number of plants which are conspicuously different in their appearance. This fact has led the author to the supposition that they might be distinguished by the difference of their karyotypes. The cytological examination has however, contrary to his expectation, shown that the karyotype is always the same, and corresponds to that of the  $F_1$  plant.

**440. Beeinträchtigung des Zellteilungsvorganges durch niedere Temperatur bei der Mikrosporenbildung der Reispflanze.** (Japanisch). Kwan'iti SAKAI. (Proc. Crop Sc. Soc. Japan **9**, 1937, 207-212, 1 Textabb. und 2 Tabellen).

Ein Reispflanzenstock in seiner Blühperiode wurde in das Eisschrank gestellt während 5-6 Stunden. Die mikroskopische Untersuchung der Mikrosporenbildung bei demselben hat gezeigt, dass während normalerweise die erste und die zweite Zellteilung nach dem sog. sukzessiven Typus stattfinden, hier die Zellteilung nicht sofort nach der ersten Kernteilung kommt, sondern die zweite Kernteilung derselben vorgeht, sodass man zwei Kernteilungsfiguren zugleich in einer und derselben Pollenmutterzelle beobachten kann. In diesem Falle wird die Spindelfigur von beiden entweder frei voneinander oder völlig bzw. teilweise miteinander verschmolzen sein. Nun wenn zum Ende der zweiten Kernteilung die Wirkung der niederen Temperatur verbleiben wird, bekommt man die zwei Tochterzellen, je mit zwei Kernen; aber wenn ihre Wirkung weiter fortsetzen wird, so wird ein Pollenkorn mit vier Kernen ausgebildet. Ob solche polykernige Pollenkörner normal fungieren können oder nicht, ist noch nicht untersucht.

**441. Beobachtungen über japanische Moosflora XV.** (M. japan. Zfg.). Kyuichi SAKURAI. (Bot. Mag. Tôkyô **51**, 1937, 791-797, 6 Textfig., 825-826).

Die folgenden neuen Arten sind beschrieben: *Fissiden jap-amabilis*, *Aongstroemia nipponica*, *Tortella spathulata*, *Mniobryum Mayebarae*, *Plagiothecium Takahashii*, *Drichomitra speciosa*, *Oxyrrhynchium arachnoideum*.

**442. Chromosome numbers of *Miscanthus* and juncaceous plants. (A preliminary note).** (Japanese). Masato SASAKI. (Japan. Jour. Gen. **13**, 1937, 260).

In *Miscanthus sinensis*, and its two varieties, *intermedius* and *variegatus*, as well as *M. japonicus* the author has seen  $2n = 36$ , in *M. saccharifera*  $2n = \pm 60$ .

In various species of the genus *Juncus* the chromosome number is different, thus  $2n = 40$ , 32 and  $\pm 60$  in *J. effusus*, *tenuis* and *prominens* respectively. In *Luzula campestris* var. *capitata*  $2n = 12$ ,  $n = 6$ .

**443. Phytogeographical and floristic studies on the islands series Kôtôsyô, generally including Kôtôsyô (Botel Tobago Isl. proper), and Kwasyôtô (Samasana Isl.). Part I. Enumeration of hitherto known indigenous pteridophytes and their geographical distribution.** Syun'iti SASAKI. (Dpt. Forest, Gov. Res. Inst., Taihoku, Taiwan (Formosa), Rpt. No. **21**, 1937, pp. 126, 18 (index), 2 pls., 97 text-figs.).

The island groups called Kôtôsyô (Botel Tobago) situated in the south of Formosa proper consists of three islands, viz. Kôtôsyô, Syôkôtôsyô and Kwasyôtô. The author has hitherto done the botanizing expedition in these islands, 11 times in the first, twice and thrice in the second and the third respectively. The present paper (Part I) is devoted especially to the enumeration of the pteridophytes growing there. The publication of Parts II and III will follow.

The pteridophytes here enumerated are included in 15 families (Danaeaceae-Psilotaceae) and contain 97 species in all. For each the map representing its distribution in the neighbouring regions is given. The paper ends with an alphabetical index of scientific names of all these plants (pp. 18).

**444. SAT-chromosomes of *Tricyrtis*. (A preliminary note).** (Japanese). Dyûhei SATÔ. (Japan. Jour. Gen. **13**, 1937, 256-258).

The cytological investigation of a certain number of *Tricyrtis* species and their interspecific hybrids has shown that the  $2n$  chromosome number is always 26. The number of the SAT-chromosomes in each, which lies between 3-6, was found to be equal to that of the nucleoli, except in some doubtful cases, thus confirming the HEITZ's hypothesis concerning the relation of these two structures. Details are indicated in a table.

**445. Enumeratio lichenum Ins. Formosae (III).** (With Japanese résumé). Masami SATÔ. (Jour. Japan. Bot. **13**, 1937, 595-599).

*Oropogon asiaticus* ASAHINA sp. nov. is described.

**446. Chromosome variation in the progeny of triploid *Lilium tigrinum*.** Masayosi SATÔ. (Cytologia, FUJII, Jub. Vol., 1937, 1056-1061, 10 text-figs.).

Though concerning *Lilium tigrinum* two kinds of chromosome numbers, viz. 12 (meiotic) and 36 (somatic) have hitherto been recorded, the plants containing the latter number (triploid) only have been met with in Japan. Also though the complete sterility of triploid *Lilium tigrinum* has been announced by several authors, the present author and some others could obtain some seeds which are able to germinate. The data given by the author in this paper are founded on the plants which are derived from such seeds.

The cytological examination of the root-tip cells of such plants has shown the remarkable variability of the chromosome number. It ranges from 24 to 39, except 31, 26 being most frequent, and 28 coming next. Besides, often the small chromo-

some fragment is found together with normal chromosomes, thus, for instance,  $25 + f$ ,  $26 + f$ ,  $27 + f$ ,  $28 + f$ . The size of chromosomes and the place of their constriction (median, submedian, terminal, subterminal) is variable. Among others the V-shaped chromosomes with submedian constriction are most conspicuous, and their number is variable, viz. 2, 4, 5.

**447. Studien über die Vermehrung der Theepflanzen mittels des Wachstumshormones.** (Japanisch). Tsunetoshi SHIBUYA. (Agric. & Hort. 12, 1937, 2559-2561, 2 Textfig.).

Ogleich die vegetative Vermehrung der Theepflanzen bisher vielfach studiert worden ist, konnte man noch zu keinem befriedigenden Resultat angekommen. Wenn aber diese Pflanze mittelst den einfachen Methoden, z.B. Stecklingen, leicht vermehrt werden können, so wird es natürlich praktisch höchst willkommen sein.

Der Verf. hat eine wässrige Lösung von Heteroauxin und  $\beta$ -Indol-propionsäure (0,01-0,04%) im Gebrauch genommen. Die kleinen Stücke des einjährigen Sprosses der Theepflanze mit 2-3 Blättern wurden in diese Lösung eingetaucht während 6-48 Stunden, und dann in das Sandbett eingesteckt, woraus nach 28-30 Tagen die Wurzelbildung an diesen Stücken einzutreten begann. Dabei ist es merkwürdig, dass im Falle, wenn die Dauer des Eintauchens in die Lösung kurz ist, die Wurzelbildung bloss nahe dem Sprossende beschränkt ist, während bei längerer Dauer des Eintauchens sie durch fast den ganzen Teil des Sprosstückes zu beobachten ist.

Bekanntlich ist die Ausfuhr der Samen von *Thea assamica* aus ihrem Heimait verboten, sodass die Vermehrung dieser Theepflanze in den anderen Regionen im vegetativen Wege vorgenommen werden muss. Durch die Behandlung dieser Theesorte nach seiner oben zitierten Methode hat der Verf. auch eine reichliche Wurzelbildung veranlassen können, wie bei den anderen Sorten.

**448. Anatomy of the wood of *Taiwania*.** (With Japanese résumé). Misaburo SHIMAKURA. (Bot. Mag. Tôkyô 51, 1937, 694-700, 12 text-figs., 722).

*Taiwania cryptomerioides* HAYATA is a monotypic genus of the family Taxodiaceae found in Formosa and South-West China. Its wood anatomy has hitherto been studied to some extent, but since something remains to be done yet, the author has performed its reinvestigation, and the results are contained in this article. The general results are briefly as below. The wood of this conifer, which is comparatively simple, is composed of tracheal elements, wood parenchyma and xylem rays with no resin-canals. The stelar development is endarch. Though the tracheal pitting of the secondary wood is usually opposite, the alternate type is often met with in the first-formed secondary wood and the last-formed primary tracheids. In the pith parenchymatous as well as stone-cells are present. The wound reactions are the increase of resin-cells, and no traumatic resin-canals are formed.

**449. Karyotype analysis in the  $F_1$  hybrids of cristate and normal form of *Rumex acetosa*.** Yosito SINOTÔ. (Cytologia, FUJII Jub. Vol., 1937, 1139-1146, 24 text-figs.).

A form of *Rumex acetosa* called cristate which is characterized by its conspicuously wrinkled and folded leaves ♀ was crossed with a normal ♂ plant with normal smooth leaves. The root-tip cells were cytologically examined. The karyotype was  $2n = 14 = 2x + 8i + 2j + 2v$  and  $2n = 15 = x + 2y + 10i + 2t$  in ♀ and ♂ respectively. 18  $F_1$  offspring were obtained, of which only three individuals showed the expected karyotype, i.e. ♀ =  $2x + 9i + t + j + v$  and ♂ =  $x + 2y + 9i + t +$

j + v. In the remaining fifteen the karyotype was different from that expected and various. Thus, for instance, in some cases t-chromosomes (those possessing trabant) were found; while in others 1-5 chromosome fragments were present. The j-chromosome with a long and a short arm was often replaced by that, where the short arm is not so long as in the typical one. Two V-shaped chromosomes ( $v_1$  and  $v_2$ ) of ♀ seem to be distributed generally equally in the  $F_1$  hybrid, thus some containing  $v_1$  and others  $v_2$ . But the irregularity often occurs, inasmuch as some contain both  $v_1$  and  $v_2$ , and others do not contain typical  $v_1$  and  $v_2$  at all.

**450. Notes of the algal flora of Manchoukuo I-IV.** (With Japanese résumé by K. OKADA). B.V. SKVORTZOV. (Bot. Mag. Tôkyô **51**, 1937, 627-635, 677-688, 738-742, 783-791, 826-825, 9 text-figs.).

The first part refers to the midsummer phytoplankton of a marshy river branch in the Sungari plain near Harbin. Flagellatae 2 genera and 8 forms, Protococcales 5 genera and 12 forms, Desmidiaceae 3 genera and 4 forms, Diatomaceae 17 genera and 51 forms, Cyanophyceae 9 genera. Among 89 algae in all about 25% are new varieties and species, and many are those newly found in these regions. *Trachelomonas scabra* known hitherto from Australia and Venezuela, *Nitzschia holsatica* known from Europe, and *N. regula* known from Tibet and Central Asia are cited as the most interesting records. All species are described.

The second part contains a list of algae from a single growth of *Spirogyra* collected near Harbin. In mucilaginous masses of *Spirogyra* 30 different algae were recognized, of which most are diatoms. The following new species are recorded as the most interesting forms: *Stigeoclonium spirogyrae* sp. nov., *Tribonema tetrachlora*, *Oscillatoria Kavalehookiana* and *Navicula harbinensis*. The description of all species follows.

**451. Studies on the chromosome numbers in higher plants, with special reference to cytokinesis II.** T. SUGIURA. (Cytologia, FUJII Jub. Vol., 1937, 845-849, 27 text-figs.).

Continuation of the author's studies of counting the chromosome number in angiosperms. The results are summarized in a table; 28 species were studied.

**452. A list of chromosome number in angiospermous plants IV.** Toranosuke SUGIURA. (Proc. Imp. Acad. **13**, 1937, 430-431).

The n chromosome numbers of 37 species of dicotyledonous plants are cited.

**453. Studies in the male gametophyte in angiosperms II. Differentiation and behaviour of the vegetative and generative elements in the pollen grains of *Crinum*.** Nobuhide SUIA. (Cytologia, FUJII Jub. Vol., 1937, 920-933, 1 pl. and 16 text-figs.).

The behaviour of the vegetative nucleus and generative cell in the pollen grain in *Crinum* species were studied both in living and fixed state.

The primary microspore division gives rise to the generative and the vegetative nucleus. The latter begins soon to enlarge. Its chromaticity is soon lost, and it is only faintly stainable by the FEULGEN's method. The author thinks that in the vegetative nucleus the chromatic substance is dissolved by the action of a certain ferment, and becomes diffused homogeneously throughout the nuclear sap. In the mature pollen grain it is amoeboid in shape and stainable by FEULGEN much less than in the above mentioned stage, which shows the considerable decrease of thymonucleic acid. It may be said that the vegetative nucleus undergoes the degeneration.



On the contrary, the generative nucleus is intensely stainable by ordinary methods as well as FEULGEN's. In the mature pollen grain it is surrounded by a cytoplasmic sheath consisting of a hyaline medium with many lipid-like granules.

The chromosome number is  $n = 11$ ,  $2n = 22$  in three species of *Crinum* examined by the author.

**454. A new species *Ardisia sciaphila* SUZ.-Tokio from the laurisylvae districts of North Taiwan.** (Japanese with English résumé). SUZUKI-Tokio. (Jour. Japan. Bot. **13**, 1937, 499-510, 2 text-figs.).

*Ardisia sciaphila* sp. nov. is described in detail. It is found scattered in the laurisylvae district of North Taiwan, 600-700 m above sea-level.

**455. *Spicilegium pteridographiae Asiae Orientalis* 14.** (With Japanese résumé). Motozi TAGAWA. (Acta Phytotax. et Geobot. **6**, 1937, 154-168).

The following new species are described among others: *Dryopteris kominatoensis*, *D. cacaia*, *Thelypteris Simozawae*, *Polystichum pseudo-deltodon*, *P. Fukuyamae*, *P. parvipinnatum*, *Athyrium tripinnatum*.

**456. *Stenoloma* of Japan.** (Japanese with Latin diagnoses). Motozi TAGAWA. (Acta Phytotax. et Geobot. **6**, 1937, 224-228).

Three new species of the genus *Stenoloma* are described, and a key for their determination is given, viz. *S. littorale*, *chusanum*, and *gracile*.

**457. On Japanese species of *Humata* CAV.** (Japanese with Latin diagnoses). Motozi TAGAWA. (Acta Phytotax. et Geobot. **6**, 1937, 228-233).

Altogether 4 species are mentioned, of which *Humata macrostegia* is a new species.

**458. A review of the genus *Woodsia*.** (Japanese). Motozi TAGAWA. (Acta Phytotax. et Geobot. **6**, 1937, 251-264).

**459. Über die Entdeckung eines eigentümlichen kugeligen Lebermoosballes im Inawasiro-See.** (Japanisch). Genzo TAKAHASHI. (Jour. Japan. Bot. **13**, 1937, 521-528, 7 text-figs.).

Ausser dem früher von MIYOSHI studierten Moosball im Inawasiro-See, welcher hauptsächlich aus dem Moose *Arisotheicum squarrosus* f. *submersum* ausgebildet ist (vgl. diesen JOURNAL **8**, (71), No. 71) fand neuerdings der Verf. auch im Inawasiro-See einen eigentümlichen Ball, welcher kleiner und grüner ist als der obengenannte Moosball. Er wird hauptsächlich aus einem Lebermoos *Aplozia nipponica* SAK. et TAKAHASHI sp. nov. ausgebildet.

**460. Über einen künstlich erzeugten triploiden Artbastard von *Chrysanthemum*.** (Japanisch m. deutsch. Zfg.). Teichiro TAKEMOTO. (Bot. Mag. Tōkyō **51**, 1937, 866-871, 5 Textabb.).

Früher (vgl. diesen JOURNAL **8**, (110), Nr. 464) wurde durch SHIMOTOMAI und Verf. die Mitteilung gemacht, dass die ganze Chromosomengarnitur von *Chrysanthemum indicum* aus 4 untereinander beinahe homologen, je 9 Chromosomen enthaltenden Sätzen besteht ( $4 \times 9 = 36$ , autotetraploid) und weiter, dass die in jedem Satz enthaltenen Chromosomen mit denselben von *Ch. lavaedulifolium* fast identisch sind. Die Kreuzung *C. lavaedulifolium* ♀  $\times$  *Ch. indicum* ♂ gab die  $F_1$  Nachkommen, welche äusserlich intermediär zwischen beiden Eltern liegen. Die somatischen Chro-



mosomen des F<sub>1</sub>-Bastards (Wurzelspitzzellen) betragen 27, was der Summe der gametischen Chromosomenzahlen von beiden Eltern entspricht (9 + 18). Sie sind aus 3 zueinander fast homologen Sätzen zusammengesetzt, woher dieser Bastard als ein Autotriploid zu betrachten ist. Dementsprechend sieht man in der Metaphase der heterotypischen Kernteilung der PMZ ausser den Univalenten und Bivalenten eine überwiegend Mehrzahl von Trivalenten, so z.B. 5<sub>III</sub> + 4<sub>II</sub> + 4<sub>I</sub>, 8<sub>III</sub> + 1<sub>II</sub> + 1<sub>I</sub>.

**461. On the special autosomes with reference to the sex determination of *Rumex acetosa* L.** Yo TAKENAKA. (Cytologia, FUJII Jub. Vol., 1937, 995-1002).

The facts are known that in *Rumex acetosa* male and male intersexual plants carry the genom  $15 = 12a + X + 2Y$ , and the female and the female intersexual plants that  $14 = 12a + 2X$ . The author has formerly stated that the sex-disturbing factors in the male and the female intersexual plants carrying the genom just referred to are not dependent on X- and Y-chromosomes, but on some few autosomes.

In this paper the author has published the results of several hybridization experiments between normal female and male, abnormal female and male by male and female intersexes, and also their reciprocals. On the basis of the results derived from such hybridization experiments the author comes to the conclusions that some of the autosomes of the male and the female intersexes contain the male and the female factors respectively, that the male intersexual chromosomes weaken the functions of autosomes (maleness) and also the female intersexual chromosomes suppress the function of X-chromosomes (femaleness), that the female intersexual factors are concerned with more numerous chromosomes than the male intersexual factors are, and further, that the origin of the sex-influencing chromosomes seems to be due to irregular divisions of the autosomes.

**462. Cytogenetic studies of *Crocus*.** (Japanese). Yo TAKENAKA. (Japan. Jour. Gen. 13, 1937, 217-219).

Though the somatic chromosome number in *Crocus sativus* is considered to be 24 by a great number of authors, MATHER gives for its two varieties, *capparidocum* and *Elwesii*, 14 and 15 respectively, so that in this case 7 should be regarded as the basic number. The result of observation of the present author is in accord with that of many authors above indicated, inasmuch as he has found 24 chromosomes. He thinks further that in *Crocus sativus* he deals with a case of autotriploidy  $3 \times 8$ .

In *C. susianus* and *moesiacus* KARASAWA has observed 15 chromosomes for each, while the author has found 14.

For various strains of *C. verduis* the somatic chromosome number corresponds, so far as the results of investigation hitherto done will show, to a certain multiple of either 8 or 10. On the basis of investigation on 19 strains of this species the author thinks that in all the basic number is 8, and their chromosome number corresponds either to a certain multiple or its transformation, due to translocation, elimination, crossing over, etc.

**463. Zur Physiologie der Essigbakterien III. Vergleichende Untersuchungen über die oxydativen Leistungen von Essigbakterien. -IV. Über den Einfluss der verschiedenen Giftstoffe auf die oxydativen Umsetzungen der Essigbakterien. -V. Über die Oxydierbarkeit von verschiedenen Alkoholen und Aldehyden.** Kiyosi TANAKA. (Jour. Sc., Hiroshima University, Ser. B, Div. 2, 3, 1938, 69-99, 101-120, 121-134).

Ad III.—In der letzten Mitteilung über diese Untersuchungsreihe (Acta Phytochim. 8, 1935, 285) wurde die Tatsache bekannt gemacht, dass eine Essigbakterie, *Bact. aceti*, unter den dort untersuchten organischen Säuren nur Essig-, Bernstein-, Fumar-, Äpfel-, Brenztrauben- und Milchsäure vollkommen und zwar ungefähr gleich schnell verbrennen kann. Es ist nun mit 8 anderen Arten von Essigbakterien festgestellt worden, dass diese Tatsache allgemein für Essigbakterien ohne weiteres gültig ist. Für die THUNBERG-WIELANDSche Hypothese über die biologische Verbrennung der Essigsäure (2 Essigsäure  $\rightarrow$  Bernsteinsäure  $\rightarrow$  Fumarsäure  $\rightarrow$  Äpfelsäure  $\rightarrow$  Oxallessigsäure  $\rightarrow$  Brenztraubensäure  $\rightarrow$  Acetaldehyd  $\rightarrow$  1 Essigsäure) wird dadurch ein zuverlässiger Beweis auch beim Falle der Essigbakterien vorgebracht.

Nach der Geschwindigkeit der  $O_2$ -Aufnahme durch die mit physiologischer Kochsalzlösung hergestellte Bakteriensuspension lassen sich die untersuchten Stoffe im grossen und ganzen in folgende 4 Gruppen einteilen: 1) Äthylalkohol und Acetaldehyd; 2) Ameisensäure (von einigen Bakterien wird sie aber gar nicht angegriffen), Essig-, Bernstein-, Fumar-, Äpfel-, Brenztrauben-, Milchsäure, Glycerin, Glycerinaldehyd und Glucose; 3) Gluconsäure, Mannit (bei den sogenannten ketogenen Bakterien sind diese beiden Stoffe der zweiten Gruppe anzugliedern), Glycerin-, Malein-, Malon-, Citronen-, Aconit-, Asparagin-, Glutaminsäure und Asparagin; 4) Propion-, Butter-, Valerian-, Oxal-, Glykol-, Schleim-, Wein-, Benzoe-, Phenyllessig-, Salicyl-, Harnsäure, Hypoxanthin, Xanthin und Glykokoll.

Ad IV.—Der Einfluss von giftigen Substanzen, d.h. Oxal-, Glutar-, Malein-, Malon-, Ameisensäure, arsenige Säure, Na-Bisulfit, Hydroxylamin, Cu-Sulfat, Ag-Nitrat, Sublimat, Goldchlorid, Zn-Sulfat, Na-Fluorid, 8-Oxychinolinsulfosäure und Toluol, auf die Oxydation von Essig-, Bernstein-, Fumar-, Äpfel-, Brenztrauben-, Milchsäure, Äthylalkohol, Acetaldehyd und Glucose wurde untersucht, mit dem Zweck, die eine spezifische Hemmung auf obige oxydative Reaktionen ausübenden Stoffe kennenzulernen. Wider Erwarten wurde eine spezifische Hemmung durch die organischen Säuren bei Essigbakterien gar nicht wahrgenommen. Na-Bisulfit hemmt insbesondere die Oxydation von Essigsäure und Glucose, und Hydroxylamin nur die von Essigsäure. Dadurch wurde die Ansicht in Betracht gezogen, dass die Aldehydgruppe auch in Essigsäure- und Glucose-Dehydrase eine aktive Gruppe darstellt. Durch Arsenit wird die Oxydation derjenigen Säuren, welche in dem THUNBERGSchen Schema vorkommen, fast vollständig gehemmt, während die von Alkohol, Aldehyd, Glucose und Ameisensäure dadurch nicht beeinflusst wird. Die Oxydation von allen untersuchten Substanzen wurde durch schwere Metalle stark verhindert. Beim Zusatz von Goldchlorid tritt der Farbumschlag infolge der Bildung von Goldsol nur in den Ansätzen von organischen Säuren, was wohl mit intermediärer Entstehung von Ketsäuren, wie das THUNBERGSche Schema lehrt, zusammenhängt. Im Gegensatz zum Resultat von COOK, HALDANE und MAPSON (Biochem. Jour. 25, 1931, 534) über Ameisensäuredehydrase von *Bact. coli* hemmt 8-Oxychinolinsulfosäure, die als Cu-Reagens wirkt, nicht die Dehydrasewirkungen von Essigbakterien. Gestützt auf die Tatsache, dass die Blausäurehemmung auf die Sauerstoffaufnahme in Gegenwart von Äpfel-, Fumar-, Milchsäure, Alkohol und Glucose durch Toluolbehandlung vermindert wird, wurde eine Erklärung für die Beeinflussung durch Toluolbehandlung gegeben, dass infolge der Ausschaltung des Cytochromsystems eine neues HCN-unempfindliches System der  $O_2$ -Versorgung zum Vorschein kommt.

Ad V.—Mit 25 Alkoholen und 13 Aldehyden wurde die Frage geprüft, ob und in wie weit sich der Bereich der Spezifität der Alkohol- und Aldehyddehydrase erweitern lässt. Es wurde dabei gefunden, dass der Spezifitätsbereich bedeutend umfangreicher

ist als bisher angenommen. Die strukturelle Verschiedenheit der Alkohole bringt wohl aber einen wesentlichen Unterschied in der Reaktionsgeschwindigkeit hervor. Die Empfindlichkeit der  $O_2$ -Aufnahme gegen Blausäure ist weitgehend abhängig von der Dehydrierungsgeschwindigkeit des betreffenden Alkohols, und zwar weist die Dehydrierung des Äthylalkohols, die mit der grössten Geschwindigkeit verläuft, eine grösste Cyanempfindlichkeit auf. Verfasser.

**464. Eine Methode, die schwierige Artbastardierung mittelst der X-Strahlung zu erleichtern.** (Japanisch). Masao TANAKA. (Bot. & Zool. **5**, 1937, 1567).

Die erfolgreiche Bastardierung zwischen verschiedenen Arten ist nicht selten sehr schwierig auszuführen. Wenn dabei die Mutter eine kleinere Anzahl von Chromosomen aufweist als der Vater, bekommt man eine grössere Anzahl von Samen als im Falle der dazu reziproken Kreuzung, doch ist die Keimungsrate der Samen sehr niedrig. Bei der reziproken Bastardierung, dagegen, sind zwar die Samen keimfähiger, doch können davon überhaupt nur sehr wenige ausgebildet werden. Z.B. bei der Kreuzung, Spelta Weizen ♀ ( $2n = 42$ ) × Timopheevii W. ♂ ( $2n = 28$ ) sind alle Samen keimfähig, während bei der dazu reziproken Kreuzung überhaupt gar keine Samen produziert werden.

In der vorliegenden Mitteilung ist eine Methode beschrieben, womittelst der Verf. bei Spelta ♀ × Timopheevii ♂ eine ziemlich grosse Menge von guten Samen bekommen hat. Sie besteht darin, dass nachdem bei Spelta-Blüten die Staubblätter entfernt worden sind, die Pfistile derselben einer halbstündigen X-Strahlung exponiert sind, und dann nach 5 Stunden sie durch Timopheevii bestäubt werden. Aus 54 in solcher Weise behandelten Blüten bekam der Verf. 11 Samen, d.h. 20.37%. Die Samen weisen das gut ausgebildete Keim und Eiweiss auf. Die Angabe über die Keimfähigkeit solcher Samen fehlt.

**465. Chromosome number in Cyperaceae I.** Nobunori TANAKA. (Cytologia, FUJII Jub. Vol., 1937, 814-821, 27 text-figs.).

The author has studied the chromosome number in the pollen mother-cells of 19 species and 3 varieties of the Cyperaceae, incl. the genera *Bulbostylis*, *Carex*, *Cyperus*, *Heleocharis*, *Lipocarpa*, and *Scirpus*. Like his predecessors he could find the aneuploidy. Though several explanations of this phenomenon has already been advanced by various authors, all such are regarded by the present author to be too premature, unless further investigations are not carried out.

**466. Geschlechtsschrosomen bei einigen Lebermoosen VI VII.** (Japanisch m. deutsch. Zfig.). Seizi TATUNO. (Bot. Mag. Tôkyô **51**, 1937, 812-819, 860-866, 14 Textabb. m. 56 einzelnen Textfig.).

Die Geschlechtsschrosomen bei der Gattung *Frullania* wurden früher von LORBEER untersucht. Der Verf. hat deren Untersuchung wiederholt und weitere Angabe hinzugefügt. Danach ist bei ♀-Thallus zwei Geschlechtsschrosomen  $X_1$  und  $X_2$  und bei ♂ nur ein Y vorhanden.  $X_1$  und Y, welche fast gleichförmig sind, sind J-förmig und weisen zwei Einschnürungen auf, während  $X_2$  V-förmig und kleiner als  $X_1$  und Y ist, und nur eine einzige Einschnürung zeigt. Bezüglich *Marchantia polymorpha* konnte der Verf. die frühere Angabe von HAUPT bestätigen, nämlich, ♀  $8 + X$ , ♂  $8 + Y$ . *M. diptera* stimmt in dieser Hinsicht mit *M. polymorpha* überein. In *M. radiata*, *tosana* und *cuneiloba* ist je ein Heterochrosom vorhanden, doch sind keine Geschlechtsschrosomen nachzuweisen, indem ♀- und ♂-Thallus bezüglich ihrer Chromosomengarnitur gar keinen Unterschied aufweisen.



**467. Heterochromosomen bei Lebermoosen III. Heterochromosomen bei Gattung *Frullania*.** (Japanisch m. deutsch. Zfg.). Seizi TATENO. (Bot. Mag. Tōkyō **51**, 1937. 931-937, 6 Textabb., m. 29 einzelnen Figuren).

In 6 diözischen Arten von *Frullania*, welche zu der Untergattung *Thyopsiella* gehören, sind je 9 Chromosomen vorhanden. Die Chromosomengarnitur von ♀ und ♂ weist gar keinen Unterschied auf. Keine Geschlechtschromosomen sind nachweisbar. Unter zwei heteropyknotischen Heterochromosomen ist das eine, welches das größte unter sämtlichen Chromosomen ist, V-förmig wegen der in seiner Mitte befindlichen Einschnürung; eine subterminale Einschnürung ist auch nachzuweisen. Das andere Heterochromosom ist das kleinste unter sämtlichen Chromosomen. Wenn man diese zwei Heterochromosomen H und h nennen will, so steht die Chromosomenformel in ♀ und ♂  $7 + H + h$ .

Bei der monözischen Art, z.B. in *Frullania boninensis* der Untergattung *Galeiloba* beobachtet man das gleichartige Bild wie bei der obengenannten Art. Die Chromosomenformel ist also dazu gleich.

**468. On the blooming of *Brasenia Schreberi* F. Gmel. (I).** (Japanese). Akira TOKURA. (Jour. Japan. Bot. **13**, 1937, 829-839, 2 text-figs. and 7 tables).

The facts briefly summarized below are the results of the author's observations on *Brasenia Schreberi* in Tōkyō during the summer 1936. Each flower of this water plant belonging to the Nymphaeaceae is composed generally of 3 sepals, 3-4 petals, 17-37 stamens and 7-15 pistils. Each flower opens twice in two successive days. In the first day the peduncle with flower bud protrudes out on water surface at about 6 o'clock morning, and then the opening of the flower begins to take place gradually, and is completed after about one hour. The distance of the flower from the water surface is then only about 1 cm. in maximum, and the flower seems then chiefly to perform the female function, inasmuch as its stigma is abundantly covered with pollen coming from other flowers, and without giving much its own pollen. The flower begins to shut out at about 9 o'clock morning, and then sinks down under the water surface. In the second day, the same flower protrudes out again on the water surface at about 6 o'clock morning, and begins to open again. Its distance from the water surface is much greater than in the first day, i.e.  $\pm 3$  cm (= thrice the distance in the first day). Such considerable distance may be correlated with its male function as the pollen supplier, inasmuch as its considerable height up the water surface will it make possible to scatter pollen to a great distance. The flower sinks down again under water after a few hours, and never to protrude out again up the water surface.

The author has performed precise measurement concerning the distance of the flower from the water surface in various hours of each day, and the data obtained are shown in several tables.

**469. *Spicilegium muscologiae Asiae Orientalis* 4.** (With Japan. résumé). Reizo TOYAMA. (Acta Phytotax. et Geobot. **6**, 1937, 169-178, 5 text-figs.).

The following new species are described: *Palisadula* (gen. nov.) *japonica*, *Brotherella Takeuchii*, *Plagiothecium Niitakayamae*, *Schweschea robusta*.

**470. On diploid and triploid *Brassica-Raphanus* hybrids.** Nagaharu U, Usaburō MIDUSIMA and Kiyosi SATŌ. (Cytologia **8**, 1937, 319-326, 6 text-figs.-groups).

The hybridizations, *Brassica oleracea* var. *acephala* ( $n = 9$ ) ♀ × *Raphanus sativus* ( $n = 9$ ) ♂ and *R. sativus* ♀ × *B. campestris* ( $n = 10$ ) ♂ have given off besides a num-

ber of  $F_1$  offspring which are morphologically intermediate between the two parents two peculiar hybrids which are distinguished from their sister plants by their strongly matroclinous nature. The comparative cytological examination has shown that while the  $F_1$  plants contain 18 and 19 somatic chromosomes respectively as a rule, these two exceptional ones are characterized by containing  $27 (= 18 + 9)$  and  $28 (19 + 9)$  somatic chromosomes respectively. Basing on the morphological traits in each stage of the growth and the chromosome behaviour in their pollen formation the authors come to the conclusion that the extra 9 chromosomes just referred to are due to the duplication of maternal chromosome set, so that if the ordinary hybrids are denoted as  $B_0R$  and  $RB_0$  respectively, the two exceptional ones should be denoted as  $B_0B_0R$  and  $RRB_0$  ( $B_0$ ,  $B_0$  and  $R$  genomes of *B. oleracea*, *B. campestris*, and *Raphanus sativus* respectively).

In the meiosis of the pollen mother-cell of diploid hybrid, *B. oleracea* ♀ × *R. sativus* ♂ the number of bivalents consisting of loosely paired chromosomes lies between 0-3, while in diploid *R. sativus* ♀ × *B. campestris* ♂ we meet mostly with 9 univalents, rarely 3 bivalents in maximum.

In the triploid  $B_0B_0R$  9 paired and 9 unpaired chromosomes are seen. In the metaphase paired chromosomes arrange regularly in the equatorial plane, while the univalents are scattered at random throughout the entire spindle region. It is obvious that here 9 paired chromosomes are the duplicated genomes of the female plant, and 9 unpaired ones those of the male. The same behaviour is seen in the meiosis of *R. sativus* × *B. campestris*.

For the discussion at the end of the paper cf. the original.

**471. A new species of *Malus* from Korea.** (Tyôsen). (Japanese with Latin diagnosis). HOMIKI UYEKI. (Jour. Japan. Bot. **13**, 1937, 727-728, 1 text-fig.).

A new species, *Malus Halleanoides*, is described with illustrations.

**472. Mikrurgische Untersuchungen lebender Zellen in der Teilung V. Die Einwirkung des Ammoniakdampfes auf die Mitose bei den Staubfadenhaarzellen von *Tradescantia reflexa*.** Bungo WADA. (Cytologia, FUJII Jub. Bd., 1937, 785-795, 2 Textfig.).

Die Einwirkung des Ammoniakdampfes auf die sich teilenden Haarzellen des Staubfadens von *Tradescantia reflexa* wurde untersucht. Der Erfolg ist nach der gegebenen Menge des Dampfes verschieden. Im Falle, wenn sie sehr gering ist, quillt zuerst die Grundsubstanz der Chromosomen und dann das Zytoplasma an, und der achromatische Bestandteil erleidet dabei gar keine Veränderung. Wenn die Menge des Dampfes mässig ist, erfolgt die Quellung der Chromatinfäden und der Chromosomen. Die Chromatinfäden in der Prophase, welche dabei angequollen sind, entwickeln sich zu den Chromosomen wie gewöhnlich, und die Zellteilung ist vollendet. Wenn aber die Menge des Ammoniakdampfes übermässig gross ist, erfolgt zuerst die Quellung der Chromosomen und dann die des Zytoplasmas, woraus die Entmischung dieser beiden Bestandteile folgt. Alsdann aggregieren sich die Chromosomen zu einem oder zwei Klumpen, die Protoplasten sich koagulieren und die Degeneration der Teilungsfigur nachfolgt. Bei weiterer Behandlung solcher Teilungsfigur durch Ammoniakdampf quillt sie noch weiter.

**473. The entrance and migration of *Bacterium solanacearum* SMITH in tobacco plants.** WANG Gee Vong. (Japanese with English résumé). (Ann. Phytopathol. Soc. Japan **7**, 1937, 14-23, 1 pl. and 6 text-figs.).



Inoculation experiments of *Bacterium solanacearum* on tobacco plants executed by the author have shown that the infection takes place through the wounds, never through stomata or water-pores. Stigma was infected, even not wounded. The above experiments were made with bacteria cultured on potato agar or decoction. Those cultured on milk were found even to be able to infect unwounded roots, being more virulent than those cultured on potato agar or decoction. In the infection of stem and leaves the bacteria entering them through the wounds occupy the xylem-ducts, and then grow outwards towards the surrounding tissues which are damaged severely. Bacteria are often seen in the cells of pith and cortex. Bacteria occupying the xylem were found to migrate a much greater distance downwards than upwards. The rate of migration is dependent on the temperature, being greatest at 40°C and smallest at 15°.

**474. Physiological studies on the growth of the paddy rice plant in peat culture, with special reference to the peat conditions and the nitrogen source.** Sennosuké YAMAGUCHI. (Jour. Fac. Sc. Hokkaido Imp. Univ. Ser. V., 4, 1937, 143-175).

Studies on the growth of paddy rice plants were carried out by the method of pot culture with peat, clayey loam, and coarse sand soils and their mixtures, using urea, urine, ammonium sulphate and sodium sulphate as nitrogen source. The following facts were ascertained. (1) The growth of rice plants depends upon the change of hydrogen ion concentration of the medium and upon the buffer capacity of the soil. (2) The buffer capacity of peat, clayey loam and coarse sand was largest in the case of the alkali titration; that of coarse sand was smallest and that of clayey loam showed a degree intermediate between them. (3) The local difference of pH-value according to the depth in the pot was most remarkable in clayey loam, smallest in peat, and in coarse sand it was similar to peat. (4) The hydrogen ion concentration was lowered by mulching of coarse sand or clayey loam on the one hand, and by manuring of urea, urine or sodium nitrate on the other. Such reaction change favours good growth of paddy rice plants, except the application of  $\text{NaNO}_3$ . (5) The bad growth of paddy rice plants in the higher acidic region in the peat or peat extract culture may be partly due to the harmful effects of humic acids in the molecular form or of organic substances in an active form, the amount of which depends mainly upon the hydrogen ion concentration of the culture solution.

Author.

**475. Nota ad species formosanas generis *Itea* (Saxifragacearum).** Yoshimatsu YAMAMOTO. (Acta Phytotax. et Geobot. 6, 1937, 245-250, 1 text-figs.-group).

First of all, an artificial key for the determination of Formosan species and varieties of *Itea* is given. 3 species and 2 varieties are described with illustrations of their leaves.

**476. Observationes ad floram formosanam XVII-XVIII.** (With Japan. résumé). Yoshimatsu YAMAMOTO. (Jour. Soc. Trop. Agric. 9, 1937, 291-307, 1 text-fig.; 379-389, 5 text-figs.).

Continuation of the author's studies of Formosan plants in the European and American herbaria. 39 species are recorded in all.

**477. Index taihokensis IV. 1936.** YAMAMOTO-Yosimatsu, SUZUKI-Sigeyosi, MORI-Kunihiko, HOSOKAWA-Takahide, FUKUYAMA-Noriaki, SIMADA-Hidetaro. Taihoku (Taiwan) 1937, pp. 88, 1 map.

Part IV of Index taihokensis, due to the cooperated work of several botanists of the University of Taihoku above mentioned, contains the names of all new families, genera, sections, tribes, varieties, combinations, etc. of the pteridophytes, gymnosperms and angiosperms from Japan, Micronesia and Manchoukuo, which were published in 1936.

**478. Chromosomenzahlen einiger Zuckerrohr-Sorten in Formosa.** (Japanisch m. deutsch. Zfg.). Kosuke YAMASHITA. (Japan. Jour. Gen. **13**, 1937, 194-195, 2 Textfig.).

Der Verf. hat die Chromosomenzahl von drei aus Formosa mitgebrachten und schon lange vorher aus Java dorthin eingeführten Zuckerrohrsorten untersucht. Danach ist sie 107, 119 und bzw.  $\pm 115$ , was mit dem fast völlig übereinstimmt, was früher BREMER in ihrem Ursprungslande selbst (Java) aufgefunden hatte.

**479. Über eine diplo-tetraploide Chimäre bei *Triticum*.** Kosuke YAMASHITA. (Cytologia, FUJII Jub. Bd., 1937, 1062-1069, 1 Taf. u. 16 Textfig.).

An einem 29-chromosomigen Individuum von einem *Triticum*-bastard (*T. polonicum* var. *vestitum*  $\times$  *T. spelta* var. *Duhamelianum*  $F_1$ )  $\times$  *T. polonicum* trat eine trisomische 29-chromosomige Pflanze auf, die sich als eine Chimäre erwies. Bei der letzteren (als 17/41 bezeichnet) beobachtet man die diplo- und tetraploide PMZ in verschiedenen Aehren, Antheren oder Antherenfächern, aber niemals in ein und demselben Antherenfach. Die Pflanze 17/41 ist keineswegs rein äusserlich von der 28-chromosomigen Pflanze unterscheidbar; auch hat die Kreuzung der letzteren durch diese Chimärepflanze 100% Ansatz gegeben. Ein deutlicher Unterschied tritt in der beträchtlichen Grösse von PMZ und Pollenkörnern im Vergleich zu denjenigen bei den Schwesterpflanzen ein.

Bei 17/41 Pflanze beobachtete der Verf. oftmals die Kernwanderung in PMZ, welche früher anderorts durch KIHARA und LILIENFELD nachgewiesen worden ist (vgl. diesen JOURNAL **8**, (10), Nr. 41).

Bei der Meiosis in den diploiden PMZ beobachtet man in der ersten Metaphase 14 Bivalente und 1 Univalent, während dieselbe der tetraploiden PMZ durch das Eintreten der Tetravalente in wechselnder Zahl (6, 7, 9 oder selten 0) charakterisiert wird.

**480. Cytogenetic studies in artificially raised interspecific hybrids of *Papaver* VI. The trigonomic hybrid of *Papaver*.—VII. *P. somniferum* L.  $\times$  *P. bracteata* LINDL.** Kono YASUI. (Cytologia, FUJII Jub. Vol., 1937, 1101-1112, 2 pls. and 19 text-figs.; *ibid* **8**, 1937, 331-342, 36 text-figs.). (The same subject as in VII above cited in Japanese in Japan. Jour. Gen. **13**, 1937, 250-251).

The  $F_1$  plant from the cross *Papaver somniferum*  $\varnothing$   $\times$  a supposed natural hybrid between *P. orientale* and *P. bracteata*  $\sigma$  resembles mostly the male plant. The somatic chromosome number was mostly 25, which corresponds to the sum of the haploid numbers of the two parents. The PMC is ordinarily distinguished by the genom  $6II + 1III + 1I_1$ ; its division is very irregular, so that beside the tetrads, diads, triads, pentads, hexads are produced. Another kind of PMC is the enormous one, of which the chromosome number is various, and some multiploid or aneuploid gametophytes were produced. The abortive small PMC is produced as the sister-cell of the enormous one. Its nucleus is always in resting stage.

Further, the cross *P. somniferum*  $\varnothing$   $\times$  *P. bracteata*  $\sigma$  was done, in which the  $F_1$  plant shows the intermediate character between the two parents. The number of the somatic chromosomes is 18, which is equal to the sum of the haploid numbers of

both parents (11 + 7). In the diaphase of PMC 4 bivalents and 10 univalents were seen, which confirms the view that *P. somniferum* carries the genom  $4\Pi + 3I$  and there are no homologous chromosomes between the two parents. Consequently several irregularities of the chromosome behaviour are seen in the meiosis of PMC.

**481. Cyanophyceae of Japan.** (With Japanese résumé). Yûichi YONEDA. (Acta Phytotax. et Geobot. **6**, 1937, 179-209, 43 text-figs.).

In this paper 18 genera, 38 species and 5 varieties of the Japanese Cyanophyceae are enumerated. The families and genera contained in this paper are as follows: Chroococcaceae—*Microcystis* (6 sp.), *Aphanocapsa* (4), *Aphanothece* (3), *Chroococcus* (3), *Gloethece* (1), *Coelosphaerium* (37?), *Merismopedia* (2), *Synechococcus* (1); Stigonemataceae—*Stigonema* (4), *Hapalosiphon* (2); Rivulariaceae *Gloetrichia* (1); Scytonemataceae—*Tolypothrix* (1), *Scytonema* (1); Nostocaceae—*Nidularia* (1); Oscillatoriaceae—*Oscillatoria* (4), *Phormidium* (4), *Symploca* (1), *Lyngbya* (1).

**482. Über das ungleichseitige Dickenwachstum und die Verschmelzung der Wurzeln der im Torfboden wachsenden Bäume.** (Japanisch). Kunizi YOSIOKA. (Oekol. Studien **3**, 1937, 69-72, 2 Textabb.).

Im Torfboden, worunter die für Wasser undurchdringbare Bodenschicht liegt, wachsen die Seitenwurzeln seicht darin durch. In solchen Fällen erfolgt bei ihnen nicht selten ein ungleichseitiges Dickenwachstum, entweder Hypo- oder Epinastie, sodass ihre Schnittfläche, statt kreisförmig zu sein, ei-, platten-, oder T-förmig ist, und im extremen Fall werden die Brettwurzeln ausgebildet. Der Verf. hat im vorliegenden Aufsatz seine Beobachtungsergebnisse über ungleichseitiges Dickenwachstum der Wurzeln von *Abies Mariesii* MAST. im Hakkôdagebirge erwähnt. Die vom Verf. untersuchten Bäume waren zweierlei, 35 bzw. 25 cm in Durchmesser und 10 bzw. 8 m in Höhe. Die Schnittfläche der Seitenwurzel ist ei- oder langelliptisch. Die Rate <sup>vertikaler Durchmesser</sup> transversaler „ beträgt 1,413-3,110. Wenn man die in Rede stehende Rate im Zusammenhang mit dem Alter der Bäume näher studiert, so wird man finden, dass sie bis zum dreissigsten Jahre  $\pm 1$  beträgt und nacher jährlich zunimmt (so z.B. beim zehnten Jahre 0,971, beim zwanzigsten 1,1166, beim dreissigsten 0,938, beim vierzigsten 1,663, beim fünfzigsten 3,400, beim siebzigsten 4,666, beim achtzigsten 7,56, beim einhundertzehnten 11,562 usw.). Weiter ist das Dickenwachstum zuerst hyponastisch, und im Laufe der Jahre wird es allmählich epinastisch.

*Fagus sylvatica* wurde im gleichen Wald mit den obengenannten *Abies*-Bäumen zusammenwachsend aufgefunden, doch beobachtet man dabei gar kein ungleichseitiges Dickenwachstum, woraus es erhellt sich, dass dieses Phänomen auf den Erbecharakter jedes Baumes, nicht aber auf die Anpassung gegen die Umgebung gegründet ist.

Weiter beobachtet der Verf. bei *Abies* sowie *Fagus* die Verschmelzung der Seitenwurzeln, nicht nur aus einem und demselben Individuum, sondern auch aus benachbarten Bäumen. Dies Phänomen wurde bisher oft bei den anderen Bäumen auf dem Torfboden beobachtet.

**483. On the underground organs of plants in Mt. Hakkôda.** Kunizi YOSIOKA. (Ecolog. Studies **2**, 1937, 121-131, 211-324; ibid 1937, 47-60, 25 text-figs.).

For the ecological study of plant-associations, not only is the investigation of aerial organs, as hitherto generally done by many authors, but also that of subterranean organs will be of utmost importance. The author has therefore studied

the underground organs of almost all dwarf shrubs and herbs which are growing in Mt. Hakkôda in respect to their morphological and ecological properties.

First of all, plants were classified into three distinct groups according to the character of their underground organ, viz. (1) plants retaining their principal roots throughout their whole life (11.9% of the whole), (2) those where roots are replaced by rhizomes or buried stems in the course of their life (17.1%), (3) those where no principal roots are produced from the beginning (81%). The preponderance of the third group in number as just mentioned may be explained by the cold and moist climate in mountainous region.

Plants with roots which are shallow but extensive are able to propagate in various habitats (*Solidago*, *Coptis*, *Loiseleuria*), but those with deep roots (*Pentastemon*, *Peucedanum*, *Polygonum*) are restricted to open, dry detritus on rock, and those with shallow and poor roots may grow only in shady moist soil rich in humus.

The author thinks that the underground organs are mostly to be considered as constitutional characters which are scarcely adapted to the surroundings.

**484. Über die Flächenquotienten der Blätter.** (Japanisch). Kunizi YOSIOKA. (Oekolog. Studien **3**, 1937, 163-166).

Betreffend die Pflanzen von verschiedenem Habitus, Schatten-, Moor-, mesophytische und Steinpflanzen, wurden nach dem Muster von STOCKER verschiedene Dimensionsquotienten gemessen, nämlich,  $\frac{\text{Trockengewicht}}{\text{Fläche}}$ ,  $\frac{\text{Wassergehalt}}{\text{Fläche}}$ ,  $\frac{\text{Oberfläche}}{\text{Frischgewicht}}$ .

Unter den vom Verf. studierten Pflanzen sind die Quotienten  $\frac{\text{Trockengewicht}}{\text{Fläche}}$  und  $\frac{\text{Wassergehalt}}{\text{Fläche}}$  bei den Stein- und Moorpflanzen am grössten; nächst kommen dieselben bei den Mesophyten, und sie sind bei den Schattenpflanzen am kleinsten. Die Tatsache, dass bei den Moorpflanzen, welchen das Wasser reichlich zur Verfügung steht, ebenso wie bei den an den wasserarmen Orten lebenden Steinpflanzen, die Quotienten  $\frac{\text{Trockengewicht}}{\text{Fläche}}$  sowie  $\frac{\text{Wassergehalt}}{\text{Fläche}}$  gross sind, wie der Verf. eben sagte, ist dazu zuzuführen, dass beide Pflanzenarten auf den offenen Boden starker Sonneninsolation wachsen.

Weiter hat der Verf. durch die Messung der Dimensionenquotienten die Tatsache nachgewiesen, dass eine und dieselbe Schattenpflanzenart, je nachdem sie im geschlossenen Waldinnern oder am offenen Lande lebt, verschiedene Dimensionsquotienten aufweist: bei den Pflanzen vom ersteren Habitus wird man die grösseren  $\frac{\text{Trockengewicht}}{\text{Fläche}}$  sowie  $\frac{\text{Wassergehalt}}{\text{Fläche}}$  und die kleineren  $\frac{\text{Oberfläche}}{\text{Frischgewicht}}$  Quotienten als bei denselben des letzteren Habitus bekommen.

**485. Velocity of spermatoleosis and fertilization in *Dryopteris oligophlebia* C. CHR. var. *elegans* H. ITÔ.** Akira YUASA. (Bot. Mag. Tôkyô **51**, 1937, 646-671, 7 text-fis.).

Taking *Dryopteris oligophlebia* var. *elegans* in fresh state as the material of observation, the author has traced various stages of spermatoleosis. The material was put in distilled water, and the observation was done under ca 18.5°C. Some materials were treated with aceto-carmin to control the observation in living ones. The time taken for the transformation of the spherical spermatid into a spermatozoid was about 56 hours. The time taken for various stages of this process was indicated with the aid of diagrammatic figures.



Similar observations were done also about the time of fertilization by putting the prothallus in distilled water. From the phase, when the spermatozooids at first begin to swim about near the archegonium to that when the fertilization is completed, the time of about 100 minutes passes over. The time for various phases of fertilization is indicated.

**486. Studies in the cytology of Pteridophyta XIII. Some effects of chromic acid on FEULGEN'S nucleal-reaction.** Akira YUASA. (Cytologia 8, 1937, 159-204).

The nuclei of the leaf-cells in some pteridophytes fixed with a watery solution of chromic acid, show the FEULGEN'S nucleal-reaction, so long as the concentration of the fixative does not surpass a certain limit. The author is of opinion that the strong chromic acid destroys the thymonucleic acid contained in the nucleus through the oxygenating action.

**487. Studies in the cytology of Pteridophyta XIV. Spermatoteleosis and fertilization in some ferns, with special reference to border-brim.** Akira YUASA. (Japan. Jour. Bot. 9, 1937, 17-35, 1 pl. and 58 text-figs.).

**488. Studies in the cytology of Pteridophyta XV. A critical consideration of cytological fixation and staining in the sporophytic cells, prothallium cells and spermatozooids of *Dryopteris uniformis* MAKINO.** Akira YUASA. (Japan. Jour. Bot. 9, 1938, 145-191).





# Weitere Untersuchungen über die pentaploiden *Triticum*-Bastarde IX

## Aequations- und Zertationskreuzungen des Bastards

*T. durum* × *T. vulgare*<sup>(1)</sup>

Von Seiji MATSUMURA

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Hierzu 5 Textabbildungen und 11 Tabellen

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(Eingegangen am 4. Dezember 1938)

### Einleitung

In der IV. und VI. Mitteilung dieser Serie haben wir die Häufigkeit der verschiedenenchromosomigen Gonen des Bastards *T. polonicum* × *T. spelta* mittels vorgenommener Rückkreuzungen zu beiden Eltern festgestellt. Ferner wurde auch in der VIII. Mitteilung die Beziehung zwischen der Chromosomenzahl und der Entwicklung der Endospermen sowie der Zeitdauer bis zur Keimung der Körner in den Rückkreuzungen des gleichen Bastards näher untersucht. Die vorliegende Mitteilung ist der Häufigkeit der in den Rückkreuzungen des Bastards *T. durum* × *T. vulgare* gefundenen verschiedenchromosomigen Gonen gewidmet, über die in einer früheren Mitteilung dieser Serie bereits berichtet wurde (KIHARA, WAKAKUWA u. YAMAMOTO, 1933). Auch hier wurden die Gestalt und die Keimung der verschiedenchromosomigen Körner bei denselben Kreuzungen untersucht.

Es liegen, diese Verbindung *T. durum* × *T. vulgare* betreffend, über die Häufigkeit der verschiedenchromosomigen Gonen der Aequations- und Zertationskreuzungen Angaben von SAX (1928), THOMPSON und CAMERON (1928), KIHARA, WAKAKUWA und YAMAMOTO (1933) und YAMASHITA (1937) vor. Eine Uebersicht über die bisherigen Beobachtungen gestatten die Tabellen 1 und 2.

Die in der Tabelle 1 gebrachten Aequationskreuzungen stellen sich ganz verschieden dar, je nachdem *T. vulgare* oder *T. durum* den Pollen zu der Rückkreuzung geliefert hatte. In ersterem Falle lag die Mode bei 18, in letzterem bei 14. Bei der Kreuzung mit *T. durum* war die hohe

(1) Contributions from the Laboratory of Genetics, Biological Institute, Department of Agriculture, Kyoto Imperial University, No. 97.

TABELLE 1. Häufigkeit der in den Aequationskreuzungen gefundenen verschieden-chromosomigen Eizellen des Bastards *T. durum* × *T. vulgare* auf Grund der bisherigen Untersuchungen

Kreuzung	Autor	Chromosomenzahl								Summe
		14	15	16	17	18	19	20	21	
$F_1 \times$ <i>T. vulgare</i>	THOMPSON u. a. (1928)	5	2	5	4	5	4	—	1	26
	KIHARA u. a. (1933)	4	3	2	6	9	5	2	—	31
	Summe	9	5	7	10	14	9	2	1	57
$F_1 \times$ <i>T. durum</i>	SAX (1928)	42	21	17	9	7	2	3	2	103
	THOMPSON u. a. (1928)	15	4	7	8	8	4	3	3	52
	KIHARA u. a. (1933)	37	16	15	4	1	3	1	4	81
	YAMASHITA (1937)	9	17	19	14	14	7	2	1	83
	Summe	103	58	58	35	30	16	9	10	319

Frequenz der 14-chromosomigen Eizellen noch auffälliger, mit Ausnahme des Resultats von YAMASHITA. Auch bei den Zertationskreuzungen war, wie aus Tabelle 2 zu ersehen ist, das Zahlenverhältnis bei hexaploidem und tetraploidem Weizen als Mutter sehr verschieden. Im letzteren Falle gelangten die minderchromosomigen Spermakern am häufigsten zur Befruchtung. In der Verbindung *T. vulgare* ×  $F_1$  waren die durch die Befruchtung mit 14- und 21-chromosomigen Spermakernen erzeugten Individuen ungefähr in gleicher Anzahl vertreten.

TABELLE 2. Häufigkeit der in den Zertationskreuzungen gefundenen verschieden-chromosomigen Pollenkörner des Bastards *T. durum* × *T. vulgare* auf Grund der bisherigen Untersuchungen

Kreuzung	Autor	Chromosomenzahl									Summe
		14	15	16	17	18	19	20	21		
<i>T. vulgare</i> × F <sub>1</sub>	THOMPSON u. a. (1928)	8	4	2	1	1	1	2	5	24	
	KIHARA u. a. (1933)	6	7	2	2	4	2	1	8	32	
	Summe	14	11	4	3	5	3	3	13	56	
<i>T. durum</i> × F <sub>1</sub>	SAX (1928)	32	11	3	2	4	2	—	2	56	
	THOMPSON u. a. (1928)	15	9	4	3	2	2	1	8	44	
	KIHARA u. a. (1933)	12	8	2	—	1	—	—	—	23	
	Summe	59	28	9	5	7	4	1	10	123	

In den von den früheren Autoren durchgeführten Aequations- und Zertationskreuzungen war der Kreuzungserfolg ziemlich gering mit Ausnahme desselben von YAMASHITA. Der Kreuzungserfolg in den vorliegen-

den Aequations- und Zertationskreuzungen war merklich besser als in den Versuchen des Jahres 1933 (vgl. Tab. 2 der III. Mitt.).

Aus den Rückkreuzungsversuchen der Verbindung *T. polonicum*  $\times$  *T. spelta* in der IV. und VI. Mitteilung geht hervor, dass die Häufigkeitsdifferenz der verschiedenchromosomigen Gonon zwischen den beiden Aequationskreuzungen  $F_1 \times T. spelta$  und  $F_1 \times T. polonicum$  sowie den beiden Zertationskreuzungen *T. spelta*  $\times$   $F_1$  und *T. polonicum*  $\times$   $F_1$  sich bei hohem Kreuzungserfolg ausgleicht. Die vorliegende Untersuchung wurde auch mit der Verbindung *T. durum*  $\times$  *T. vulgare* ausgeführt, um eventuell durch ein hierbei ähnliches Ergebnis die Richtigkeit dieser Beobachtung zu bestätigen. Aber das Resultat stellte sich etwas verschieden dar, je nachdem ob *T. vulgare* oder *T. durum* als ein Elter zu der Rückkreuzung mit dem  $F_1$ -Bastard benutzt wurde. Es dürfte dies auch in engem Zusammenhange mit dem Kreuzungserfolg, besonders der Keimungsunfähigkeit der runzeligen Körner, stehen.

## Material und Methoden

Bei den pentaploiden Bastarden meiner Untersuchung wurden *Triticum vulgare* VILL. var. *erythrospermum* KÖRN. als Dinkelelter und *T. durum* DESF. var. *Reichenbachii* KÖRN. als Emmerart benutzt. Die gleichen Bastarde wurden in der III. Mitteilung dieser Serie zu den Versuchen von KIHARA, WAKAKUWA und YAMAMOTO herangezogen. Die  $F_1$ -Bastarde und die Rückkreuzungen des Bastards mit beiden Eltern waren reziprok erzeugt worden.

Zuerst habe ich im Jahre 1935 beide Zertationskreuzungen, *T. vulgare*  $\times$   $F_1$  und *T. durum*  $\times$   $F_1$ , ausgeführt. Die Körner wurden mittags am 14. November in der letzteren Verbindung bzw. am 15. November in der ersteren im Zimmer in viereckigen Pflanzentöpfen mit sterilem Sand ausgesät. Im Laufe des Winters gingen viele Keimlinge ein. Bei sämtlichen überlebenden Pflanzen zählte ich dann die somatischen Chromosomenzahlen in den Wurzelspitzen, die im April 1936 fixiert wurden.

Im nächsten Jahre (1936) habe ich diese Zertationskreuzungen wiederholt. Ferner wurden gleichzeitig beide Aequationskreuzungen,  $F_1 \times T. vulgare$  und  $F_1 \times T. durum$  ausgeführt. Die Körner dieser Verbindungen wurden im Gewächshaus in Holzkisten mit steriler Erde mittags am 23. Oktober desselben Jahres zur Keimung gebracht. Im Dezember wurden wieder die Wurzelspitzen der Keimlinge fixiert und die Chromosomenzahlen bestimmt.

Bei den Wurzelspitzen wurden Fixierung und Färbung auf dieselbe Weise ausgeführt wie früher (vgl. V. Mitt.). Die Herstellung der Aufnahmen von den Samen (Abb. 2–5) war die gleiche, wie ich sie in der VIII. Mitteilung bereits beschrieben habe.

F<sub>1</sub>-Bastarde

Tabelle 3 zeigt den Erfolg der reziproken Kreuzungen zwischen *T. durum* und *T. vulgare*. Abbildung 1 stellt die Samen der Bastarde

TABELLE 3. Kreuzungserfolg in reziproken Kreuzungen von  
*T. durum* × *T. vulgare* im Jahre 1936

Kreuzungsrichtung	Zahl d. bestäubten Blüten	Zahl d. Körner (%)	ausgesät	gekeimt (%)	Erfolg %
<i>T. durum</i> × <i>T. vulgare</i>	49	41(83.67)	37	13(35.14)	29.40
<i>T. vulgare</i> × <i>T. durum</i>	16	4(25.00)	4	4(100.00)	25.00

und der beiden Eltern dar. Die Anzahl der Tage bis zur Keimung dieser Körner wurde im Oktober 1936 bestimmt. Sie ist aus Tabelle 4 zu ersehen. In der Kreuzung *T. durum*



Abb. 1. Körner der Eltern  
und F<sub>1</sub>-Bastarde.

♀ × *T. vulgare* ♂ war, wie zu erwarten, der Körneransatz besser als in der reziproken Kreuzung. Aber die Samen waren alle runzelig oder eingeschrumpft, ihre Keimung merklich schlechter und langsamer und die Lebensfähigkeit der Keimlinge geringer. Dagegen zeigten die dickkörnigen Samen in der reziproken Kreuzung *T. vulgare* ♀ × *T. durum* ♂ bessere und etwas schnellere Keimung, trotzdem sie kleiner waren.

## Aequationskreuzungen

Der Kreuzungserfolg der Aequationskreuzungen des Bastards *T. durum* × *T.*

TABELLE 4. Die Anzahl der Tage bis zur Keimung der  
Körner bei Eltern und F<sub>1</sub>-Bastarden

Tage bis zur Keimung	4	5	6	Summe
<i>T. durum</i>	4	5	1	10
<i>T. vulgare</i>	6	4		10
<i>T. durum</i> × <i>T. vulgare</i>	5	3	2	10
rez.	3	1		4



TABELLE 5. Kreuzungserfolg bei den Acquationskreuzungen

Kreuzung	Zahl d. bestäubten Blütchen	Zahl d. Körner (%)	ausgesät	gekeimt (%)	(von d. Keiml. ein- gegangen)*	Erfolg %
$F_1 \times T. \textit{vulgare}$	196	111(56,63)	111	60(54,05)	(3)	30,61
$F_1 \times T. \textit{durum}$	167	83(49,70)	83	79(95,18)	(6)	47,30

\* Die Chromosomenzahlen dieser Keimlinge wurden nicht bestimmt.

*vulgare* mit *T. vulgare* und *T. durum* findet sich in Tabelle 5. Aus dieser Tabelle geht klar hervor, dass bei der Kreuzung  $F_1 \times T. \textit{vulgare}$  die Keimung merklich schlechter als bei der Kreuzung  $F_1 \times T. \textit{durum}$  ist. Die Häufigkeit der verschiedenenchromosomigen Keimlinge ist aus den graphischen Darstellungen der Körner in Abbildung 2 und 3 zu ersehen.

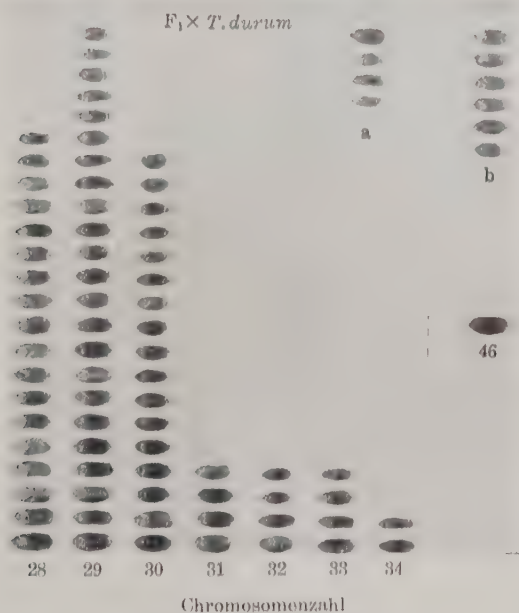
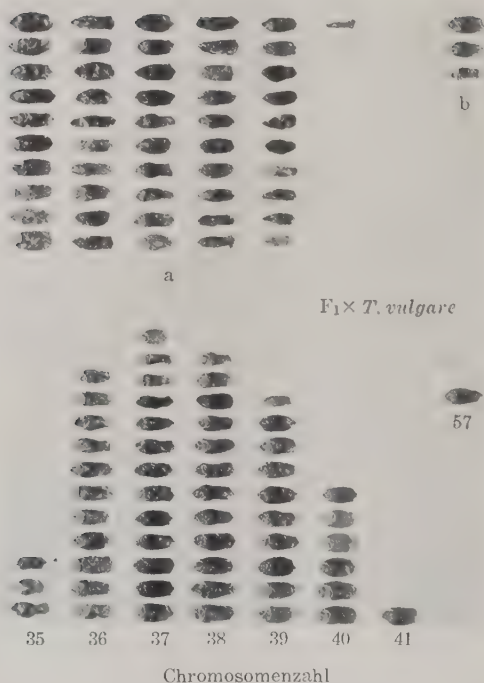


Abb. 2. Körner von  $F_1 \times T. \textit{durum}$ .

- a. ungekeimt.
- b. von d. Keiml. eingegangen.

Auch Tabelle 6 bringt die Häufigkeit der 14- bis 21-chromosomigen Eizellen des  $F_1$ -Bastards auf Grund der Acquationskreuzungen. Eine Pflanze aus der Rückkreuzung mit *T. vulgare* hatte eine unerwartete Chromoso-

Abb. 3. Körner von F<sub>1</sub> × *T. vulgare*.

a. ungekeimt.

b. von d. Keiml. eingegangen.

TABELLE 6. Häufigkeit der verschiedenchromosomigen Eizellen des Bastards *T. durum* × *T. vulgare* auf Grund der Aequationskreuzungen

Kreuzung	Chromosomenzahl								Summe
	14	15	16	17	18	19	20	21	
F <sub>1</sub> × <i>T. vulgare</i>	3	11	13	12	10	6	1	0	56
%	5.36	19.64	23.21	21.43	17.86	10.71	1.79	—	100
F <sub>1</sub> × <i>T. durum</i>	18	23	17	4	4	4	2	0	72
%	25.00	31.94	23.60	5.56	5.56	5.56	2.78	—	100

menzahl ( $2n = 57$ ). Auch war eine bei der Verbindung mit *T. durum* wider Erwarten 46-chromosomig.

Die Variationsreihen der 14- bis 21-chromosomigen Eizellen stellen sich in beiden Aequationskreuzungen etwas verschieden dar, aber der

in den bisherigen Untersuchungen von THOMPSON und CAMERON (1928) sowie KIHARA, WAKAKUWA und YAMAMOTO (1933) sich so auffallend bemerkbar machende Unterschied ist hier nicht ebenfalls konstatierbar (vgl. Tab. 1). In diesem Versuch hatte keine einzige Befruchtung einer 21-chromosomigen Eizelle ein entwicklungsfähiges Korn gegeben. An diesem Resultat dürfte wohl die zu geringe Anzahl der untersuchten Individuen schuld sein.

Die Körner der Verbindung  $F_1 \times T. durum$  waren im allgemeinen plump und ihre Grösse schien mit der Vermehrung der Chromosomenzahl abzunehmen (Abb. 2). In der Kreuzung  $F_1 \times T. vulgare$  wurden, wie aus Abbildung 3 zu erkennen ist, zahlreiche runzelige oder eingeschrumpfte Körner gefunden, von denen viele keine Keimfähigkeit besaßen. Bei den gekeimten Samen ging die Abnahme des Grades der Schrumpfung

TABELLE 7. Korrelation zwischen der Chromosomenzahl und der Anzahl der Tage bis zur Keimung der Körner bei Aequationskreuzungen

Kreuzung	Chromosomen- zahl	Tage bis zur Keimung						Summe
		4	5	6	7	8	9	
$F_1 \times$ <i>T. durum</i>	28	11	5	2				18
	29	8	9	5		1		23
	30	3	9	5				17
	31	1	2	1				4
	32	1	1	2				4
	33		2	2				4
	34	1	1					2
	46*		1					1
	**		4	2				6
	Summe	25	34	19	0	1		79
$F_1 \times$ <i>T. vulgare</i>	35		2	1				3
	36	2	5	2	2			11
	37	2	4	2	4		1	13
	38	6	6					12
	39	5	4	1				10
	40	3	2	1				6
	41	1						1
	57*	1						1
	**		1	1	1			3
	Summe	20	24	8	7	0	1	60

\* Unerwartet

\*\* Im Keimlingsstadium eingegangen

eines Korns und der Zahl der runzeligen Körner Hand in Hand mit der Vermehrung der Chromosomenzahl. Die runzeligen und ungekeimten Körner dürften niedrige Chromosomenzahlen haben, ähnlich wie diejenigen der Kreuzung *T. durum* ♀ × *T. vulgare* ♂ (vgl. VIII. Mitt.).

Die Korrelation zwischen der Chromosomenzahl und der Anzahl der Tage bis zur Keimung der Körner bringt Tabelle 7. In der Verbindung  $F_1 \times T. vulgare$  mit 35 bis 42 Chromosomen ist deutlich eine negative Korrelation zu erkennen, deren Koeffizient  $r = -0.3668 \pm 0.0780$  ist. Je kleiner die Chromosomenzahlen der Körner oder je runzeliger letztere sind, desto länger dürfte die Zeit bis zur Keimung währen. Die Verbindung  $F_1 \times T. durum$  mit 28- bis 35-chromosomigen Körnern weist auch eine positive Korrelation mit dem Koeffizienten  $r = +0.2151 \pm 0.0758$  auf. In dieser Kreuzung mit plumpen Körnern möchten demnach die grösseren Körner etwas schneller keimen als die kleineren.

Eine unerwartete Pflanze mit 57 Chromosomen bei  $F_1 \times T. vulgare$  wurde in Pollenmutterzellen untersucht. Viele Trivalenten wurden beobachtet. Diese Pflanze mag wohl durch die Verschmelzung einer unreduzierten 36-chromosomigen Eizelle (durch Verdoppelung des 18-chromosomigen Kerns) mit einem 21-chromosomigen Spermakern entstanden sein. Eine andere unerwartete Pflanze mit 46 Chromosomen bei  $F_1 \times T. durum$  hat nicht geschosst. Für die Entstehung dieser Pflanze mag eine ähnliche Erklärung zutreffen, indem sie sich nämlich auf die Verbindung zwischen einer unreduzierten Eizelle mit 32 Chromosomen und einem 14-chromosomigen Spermakern zurückführen lässt. Ähnlich haben bereits KIHARA und WAKAKUWA (1935) eine unerwartete 48-chromosomige Pflanze bei der Rückkreuzung des Bastards *T. polonicum* × *T. spelta* mit *T. polonicum* erhalten.

TABELLE 8. Kreuzungserfolg bei den Zertationskreuzungen

Versuch	Kreuzung	Zahl d. bestäubten Blütchen	Zahl d. Körner (%)	ausgesät	gekeimt (%)	(von d. Keiml. eingegangen)*	Erfolg %
I	$T. vulgare \times F_1$	201	76(37.81)	75	70(93.33)	(25)	35.29
	$T. durum \times F_1$	202	110(54.45)	107	75(70.09)	(26)	38.17
II	$T. vulgare \times F_1$	198	70(35.35)	70	65(92.86)	( 5)	32.83
	$T. durum \times F_1$	204	117(57.35)	117	80(68.38)	( 3)	39.22
Summe	$T. vulgare \times F_1$	399	146(36.59)	145	135(93.10)	(30)	34.07
	$T. durum \times F_1$	406	227(55.91)	224	155(69.20)	(29)	38.69

\* Die Chromosomenzahlen dieser Keimlinge wurden nicht bestimmt.

# Zertationskreuzungen

Tabelle 8 bietet die Bestäubungs- und Keimungserfolge der Zertationskreuzungen des Bastards *T. durum*  $\times$  *T. vulgare* mit beiden Eltern. Die Ergebnisse stellen sich in den beiden Versuchen I und II ganz ähnlich dar. Bei der Verbindung *T. vulgare*  $\times$   $F_1$  war, wie zu erwarten, die Keimung auffallend besser als bei *T. durum*  $\times$   $F_1$ . In Versuch I wurden, wie oben erwähnt, die Körner im Jahre 1935 ausgesät und die Fixierung

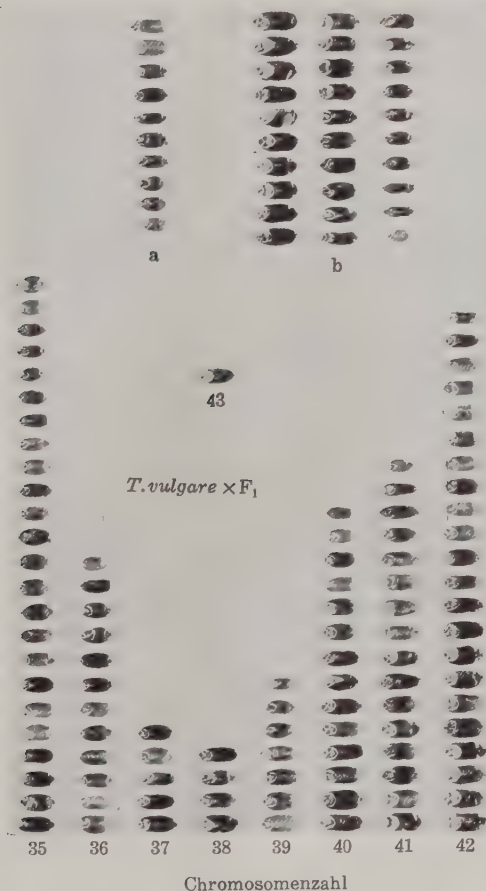


Abb. 4. Körner von *T. vulgare*  $\times$   $F_1$ .

- a. ungekeimt.
- b. von d. Keiml. eingegangen.



der Wurzelspitzen der Keimlinge im April 1936 vorgenommen. Daher gingen viele Keimlinge im Laufe des Winters ein, deren Chromosomenzahlen nicht festgestellt wurden. In Versuch II wurden die Kreuzungen im Jahre 1936 ausgeführt und die Wurzelspitzen der Keimlinge im Dezember desselben Jahres fixiert. Bei nur 5 Pflanzen in der Verbindung *T. vulgare*  $\times$   $F_1$  und bei 3 in *T. durum*  $\times$   $F_1$ , die im Keimlingsstadium eingegangen sind, wurden die Chromosomenzahlen nicht bestimmt.

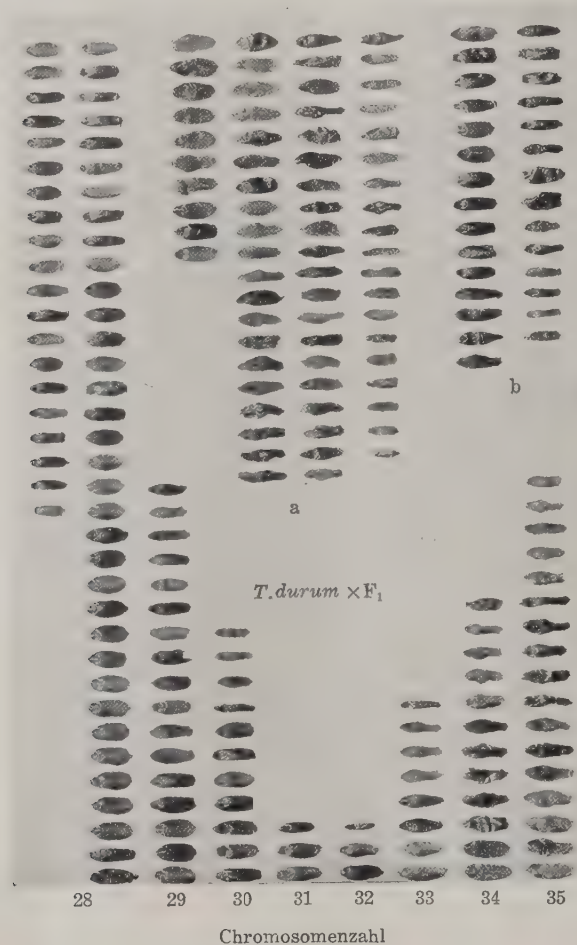


Abb. 5. Körner von *T. durum*  $\times$   $F_1$ .

- a. ungekeimt.
- b. von d. Keiml. eingegangen.

Tabelle 9 bringt die Häufigkeit der 14- bis 21-chromosomigen Spermakerne auf Grund dieser Zertationskreuzungen; eine Pflanze mit unerwarteter Chromosomenzahl ( $2n = 43$ ) bei *T. vulgare*  $\times$   $F_1$  in Versuch I wurde hier nicht berücksichtigt. In den Abbildungen 4 und 5 handelt es sich um die graphischen Darstellungen der Körner, wobei die Resultate von beiden Versuchen I und II gemeinsam wiedergegeben sind.

TABELLE 9. Häufigkeit der verschiedenchromosomigen Pollenkörner des Bastards *T. durum*  $\times$  *T. vulgare* auf Grund der Zertationskreuzungen I und II

Kreuzung		Chromosomenzahl								Summe
		14	15	16	17	18	19	20	21	
I	<i>T. vulgare</i> $\times$ $F_1$	12	3	4	3	1	5	6	10	44
	<i>T. durum</i> $\times$ $F_1$	21	6	4	1	2	3	6	6	49
II	<i>T. vulgare</i> $\times$ $F_1$	12	9	1	1	6	9	10	12	60
	<i>T. durum</i> $\times$ $F_1$	34	11	7	2	1	5	6	11	77
Summe	<i>T. vulgare</i> $\times$ $F_1$	24	12	5	4	7	14	16	22	104
	%	23.08	11.54	4.81	3.85	6.73	13.46	15.38	21.15	100
	<i>T. durum</i> $\times$ $F_1$	55	17	11	3	3	8	12	17	126
	%	43.65	13.49	8.73	2.38	2.38	6.35	9.53	13.49	100

Aus der Tabelle 9 geht ohne weiteres hervor, dass die Zahlenreihen in Versuch I und II ähnlich sind. Die festgestellten Zahlen sind aber in den beiden Rückkreuzungen mit *T. vulgare* und *T. durum* deutlich verschieden (Abb. 4 u. 5). Bei *T. vulgare*  $\times$   $F_1$  waren die durch die Befruchtung mit (18–21)-chromosomigen Spermakernen erzeugten Pflanzen (59) zahlreicher als diejenigen mit (14–17)-chromosomigen (45). Diese Befunde sind im Vergleich ganz verschieden von denen bei den bisherigen Untersuchungen (vgl. Tab. 2). Jedoch waren die mit 21- und 14-chromosomigen Spermakernen befruchteten Individuen ungefähr in gleicher Anzahl vertreten. Bei *T. durum*  $\times$   $F_1$  wurden dagegen die Spermakerne mit niedrigen Chromosomenzahlen am häufigsten befruchtet.

Die dickkörnigen Samen, die eine gute Keimfähigkeit aufwiesen, wurden im allgemeinen bei *T. vulgare*  $\times$   $F_1$  festgestellt. Die Abnahme der Grösse der Körner geht Hand in Hand mit der Verminderung der Chromosomenzahl. Die 35-chromosomigen Körner waren am kleinsten und ähnlich wie diejenigen der Kreuzung *T. vulgare*  $\varphi$   $\times$  *T. durum*  $\sigma$ . Die Körner bei *T. durum*  $\times$   $F_1$  waren im grossen und ganzen länger und schlanker als die bei *T. vulgare*  $\times$   $F_1$ , zeigten aber eine schlechtere Keimfähigkeit. Die ungekeimten Samen waren fast alle runzelig oder

eingeschrumpft. Bei den verschiedenchromosomigen Körnern der Verbindung *T. durum*  $\times$   $F_1$  nimmt die Anzahl der runzeligen Samen mit der Anzahl der Chromosomen zu. Am runzeligsten waren die 35-chromosomigen Samen, wie sie die Kreuzung *T. durum*  $\varnothing \times T. vulgare$   $\sigma$  ergab. Demnach scheinen die ungekeimten runzeligen Körner hochchromosomig zu sein (vgl. VIII. Mitt.).

Die Beziehung zwischen der Anzahl der Tage bis zur Keimung und der Chromosomenzahl in beiden Zertationsversuchen I und II ist in Form einer Korrelationstabelle zur Darstellung gebracht (Tab. 10). In dieser Tabelle sind die Ergebnisse des Versuchs II in Klammern gesetzt. Aus der Zusammenfassung beider Versuche I und II ist deutlich eine Korrela-

TABELLE 10. Korrelation zwischen der Chromosomenzahl und der Anzahl der Tage bis zur Keimung der Körner bei den Zertationsversuchen I und II

Kreuzung	Chromo- somen- zahl	Tage bis zur Keimung													Summe
		3	4	5	6	7	8	9	10	11	12	13	14		
<i>T. durum</i> × F <sub>1</sub>	28	6(9)	11(23)	2(2)	1	1								21(34)	
	29	3(7)	1(3)	1(1)				1						8(11)	
	30	3(4)	(2)	1(1)										4 (7)	
	31	1(2)												1 (2)	
	32	(1)			1				1					2 (1)	
	33	1(1)	2(2)	(1)	(1)									3 (5)	
	34	(2)	(3)	3(1)	1	1	1							6 (6)	
	35	2(5)	2(5)	2 (1)										6(11)	
	**	9	12(2)	2(1)		1				1	1			26 (3)	
	Summe	25(31)	28(40)	12(8)	2(1)	3	2	1	1	1				75(80)	
<i>T. vulgare</i> × F <sub>1</sub>	35	2	4(2)	1(7)	1(3)	1	2		1					12(12)	
	36	1	1(3)	1(5)	(1)									3 (9)	
	37	1	2	1(1)										4 (1)	
	38	1	2(1)											3 (1)	
	39		1(3)	(3)										1 (6)	
	40	1	4(6)	(3)										5 (9)	
	41	3	2(8)	1(2)										6(10)	
	42	5	5(10)	(2)										10(12)	
	43*		1											1	
	**	9	5(1)	4(2)	(2)	3			3				1	25 (5)	
Summe	23	27(34)	8(25)	1(6)	4	2	0	4	0	0	0	1	70(65)		

\* Unerwartet

\*\* Im Keimlingsstadium eingegangen

Die Ergebnisse von Versuch II sind in Klammer gesetzt.

tion mit dem Koeffizienten  $r = -0.4522 \pm 0.0526$  bei 35- bis 42-chromosomigen Körnern der Verbindung *T. vulgare*  $\times$   $F_1$  zu erkennen, während die Verbindung mit 28 bis 35 Chromosomen keine merkliche Korrelation ( $r = +0.1377 \pm 0.0589$ ) aufweist. Demnach möchten, wie schon bei den Aequationskreuzungen erwähnt wurde, die Körner desto später keimen, je runzeliger sie sind und je kleiner sie sich bei zugleich plumpem Aussehen zeigen.

Eine unerwartete Pflanze mit 43 Chromosomen in der Verbindung *T. vulgare*  $\times$   $F_1$  dürfte durch die Verschmelzung einer 21-chromosomigen Eizelle von *T. vulgare* mit einem 22-chromosomigen Spermakern des Bastards, der ein überflüssiges Chromosom enthält, entstanden sein. Eine 36-chromosomige Pflanze, die in ähnlicher Weise ein überschüssiges Chromosom aufwies, wurde bei der Rückkreuzung von *T. polonicum*  $\times$  (*T. polonicum*  $\times$  *T. spelta*) beobachtet (MATSUMURA, 1936 b u. 1937).

## Diskussion

Zuerst sei die Häufigkeit der 14- bis 21-chromosomigen Eizellen des Bastards *T. durum*  $\times$  *T. vulgare* auf Grund der Aequationskreuzungen erörtert. In diesen Untersuchungen war die Keimung bei  $F_1 \times T. vulgare$  schlechter als die bei  $F_1 \times T. durum$ . Auf Grund der Kreuzung  $F_1 \times T. vulgare$  beträgt die Zahl der (14–17)- bzw. (18–21)-chromosomigen Eizellen 39 bzw. 17, das Verhältnis ist also ungefähr 2.3 minderchromosomig: 1 höherchromosomig. Die Unfähigkeit der Keimung bei  $F_1 \times T. vulgare$  muss fast ganz darauf beruhen, dass die durch die Verschmelzung (14–17)-chromosomiger Eizellen mit 21-chromosomigen Spermakernen erzeugten Zygoten eliminieren. Wenn wir alle ungekeimten Körner als zygotische Kombinationen der (14–17)-chromosomigen Eizellen mit 21-chromosomigen Spermakernen voraussetzen, so erhalten wir nicht 39 sondern 90 minderchromosomige Eizellen gegen 17 höherchromosomige. Daraus folgt, dass ungefähr 5 mal so viel minderchromosomige befruchtet haben als höherchromosomige. Dieses Zahlenverhältnis kommt also an dasjenige bei der Kreuzung  $F_1 \times T. durum$  heran, das ungefähr das von 6 minder-: 1 höherchromosomig ist. Aber noch sind die Zahlen des Verhältnisses bei  $F_1 \times T. vulgare$  nach vorgenommener Korrektur (ca. 5:1) von dem bei  $F_1 \times T. durum$  (ca. 6:1) etwas verschieden. Dieser kleine Unterschied, falls er bedeutsam ist, muss demnach auf den geringen Körneransatz der Kombination höherchromosomiger Embryosäcke mit 14-chromosomigen Pollen bei  $F_1 \times T. durum$  beruhen.

Die in der III. Mitteilung dieser Serie (KIHARA, WAKAKUWA und YAMAMOTO, 1933) besprochenen Aequationskreuzungen stellten sich ganz verschieden dar, je nachdem das hexaploide oder tetraploide Elter den

Pollen zu der Rückkreuzung geliefert hatte (vgl. Tab. 1). Zur Erklärung dieses auffallenden Unterschiedes haben sie folgende zwei Möglichkeiten in Betracht gezogen: 1. Selektive Befruchtung der (18–21)-chromosomigen bzw. (14–17)-chromosomigen Eizellen im Rückkreuzungsversuch  $F_1 \times$  Dinkel bzw.  $F_1 \times$  Emmer und 2. Elimination der aus der Verbindung von (14–17)-chromosomigen Eizellen mit 21-chromosomigen Spermakernen gebildeten Zygoten bei  $F_1 \times$  Dinkel infolge von mangelhafter Keimung. Nach den in der III. Mitteilung besprochenen Resultaten mit niedrigem Kreuzungserfolg lag die Mode in der Verbindung  $F_1 \times T. durum$  bei 14. Wenngleich wir auch eine Korrektur für die schlechtere Keimung der minderchromosomigen Zygoten bei  $F_1 \times T. vulgare$  vornehmen, vermögen wir doch nicht den besonders scharfen Unterschied zwischen  $F_1 \times T. vulgare$  und  $F_1 \times T. durum$  auszugleichen. Demnach muss dieser Unterschied in erster Linie auf den 1. Faktor, die selektive Befruchtung, zurückgeführt werden. In den gegenwärtigen Untersuchungen mit höherem Kreuzungserfolg als früher könnte dagegen der oben besprochene 2. Faktor, d.h. die Elimination der Zygoten mit minderen Chromosomenzahlen bei  $F_1 \times T. vulgare$ , eine grössere Rolle als der 1. Faktor spielen. Je schlechter der Kreuzungserfolg ist, desto grösser dürfte daher die Häufigkeitsdifferenz der verschiedenchromosomigen Gonen zwischen beiden Aequationskreuzungen,  $F_1 \times$  Dinkel und  $F_1 \times$  Emmer, sein. Umgekehrt müsste sich schliesslich diese Differenz bei hohem Kreuzungserfolg ausgleichen, wie bei den Aequationsversuchen des Bastards  $T. polonicum \times T. spelta$  (vgl. IV. Mitt.).

TABELLE 11. Theoretische Häufigkeit der verschiedenchromosomigen Gonen bei verschiedener Univalentenelimination

Chromosomenzahl	14	15	16	17	18	19	20	21
$(0.5+0.5)^7$	0.78	5.47	16.41	27.34	27.34	16.41	5.47	0.78
$(0.55+0.45)^7$	1.52	8.72	21.40	29.19	23.88	11.72	3.20	0.37
$(0.575+0.425)^7$	2.08	10.75	23.84	29.37	21.71	9.63	2.37	0.25
$(0.6+0.4)^7$	2.80	13.07	26.13	29.03	19.35	7.74	1.72	0.16
$(0.625+0.375)^7$	3.73	15.65	23.16	23.16	16.90	6.08	1.22	0.10
$(0.65+0.35)^7$	4.90	18.48	29.85	26.78	14.42	4.66	0.84	0.07
$(0.675+0.325)^7$	6.38	21.52	31.08	24.94	12.01	3.47	0.56	0.04
$(0.7+0.3)^7$	8.23	24.71	31.77	22.69	9.72	2.50	0.36	0.02

Ferner wollen wir den Grad der Univalentenelimination beim Bastard  $T. durum \times T. vulgare$  mit dem bei der Verbindung  $T. polonicum \times T. spelta$  vergleichen. Ein Vergleich der theoretischen Zahlen in Tabelle 11 mit den beobachteten in Tabelle 6 ergibt eine stärkere Univalenten-



elimination. Das theoretische Zahlenverhältnis zwischen (14–17)- und (18–21)-chromosomigen Gonon bei stärkerer Elimination, das aus der Formel  $(0.675 + 0.325)^7$  gewonnen wird, ist 83.92% : 16.08% (ca. 5:1). Demnach beträgt die Univalentenelimination beim Bastard *T. durum* × *T. vulgare* ungefähr 35%. Sie ist also gradmässig stärker als die bei der Verbindung *T. polonicum* × *T. spelta*, wo eine mässige Elimination auf Grund der Formel  $(0.6 + 0.4)^7$  berechnet wird (vgl. VI. Mitt.). Diese Befunde stimmen mit den von KIHARA (1924) beobachteten überein. Auf Grund der Zählung der Zwergkerne in der Tetradenbildung hat letzterer bereits konstatiert, dass die Chromosomenelimination bei *T. durum* × *T. vulgare* bedeutend grösser ist als die bei *T. polonicum* × *T. spelta*.

In Anbetracht der schlechten Keimung bei  $F_1$  × *T. vulgare* und dem niedrigen Körneransatz bei  $F_1$  × *T. durum* ergibt sich schliesslich für die gegenwärtige Untersuchung das Verhältnis der minder- und höherchromosomigen Eizellen beim Bastard *T. durum* × *T. vulgare* als ungefähr 5:1. Aus der Zählung der Chromosomen in der ersten Kernteilung der jungen Pollenkörner des gleichen  $F_1$ -Bastards haben wir ein ähnliches Verhältnis festgestellt (Diese Untersuchung soll in einer der nächsten Mitteilungen dieser Serie ihre Veröffentlichung finden). Sowohl die weiblichen wie die männlichen Gonon mit 14 bis 21 Chromosomen müssen demnach bei dieser Verbindung *T. durum* × *T. vulgare* mit der gleichen Häufigkeit gebildet werden. Dies steht im Einklang mit dem Ergebnis beim Bastard *T. polonicum* × *T. spelta*, in dem die weiblichen und männlichen Gonon die gleiche Univalentenelimination aufweisen (vgl. VI. Mitt.).

Die Zahlenreihen der Zertationskreuzungen sind nun wie folgt abzuleiten.

Es ist selbstverständlich, dass die J- bzw. U-förmige Verteilung der Abbildungen 4 und 5 die Schärfe der Konkurrenz zwischen den eu- und aneuploiden Pollen demonstriert (vgl. III. u. VI. Mitt.). Wie die Zusammenfassung der Versuche I und II in Tabelle 9 ergibt, sind die Variationsreihen in den beiden Rückkreuzungen mit *T. durum* und *T. vulgare* deutlich verschieden. Bei *T. durum* ×  $F_1$  werden aus der Befruchtung mit den (14–17)- bzw. (18–21)-chromosomigen Spermakernen 86 bzw. 40 Nachkommen erhalten. Die entsprechenden Zahlen bei *T. vulgare* ×  $F_1$  sind 45 bzw. 59; das Verhältnis ist 1:1.3. Im ersteren Falle kommen die minderchromosomigen Spermakerne am häufigsten zur Befruchtung, während im letzteren die durch die Befruchtung mit höherchromosomigen Spermakernen erzeugten Pflanzen zahlreicher vertreten sind als die mit minderchromosomigen. Auf den ersten Blick scheint demnach dieser Unterschied auf die selektive Befruchtung der 14- bzw. 21-chromosomigen Eizellen durch die minder- bzw. höherchromosomigen Spermakerne zurückzuführen. Aber wir müssen die schlechtere Keimung bei *T. durum*

$\times F_1$  berücksichtigen, die fast ganz als Folge der Elimination der zygotischen Kombination von 14-chromosomigen Eizellen mit höherchromosomigen Spermakernen zu gelten hat. So gesehen, erhalten wir nicht 40, sondern 109 höherchromosomige Spermakerne gegen 86 minderchromosomige. Diese Verhältnis zwischen minder- und höherchromosomigen Spermakernen (*ca.* 1:1.3) ist daher ungefähr gleich mit dem von *T. vulgare*  $\times F_1$ .

Auch hier wollen wir nur das Zahlenverhältnis der euploiden Spermakerne in Betracht ziehen. Bei *T. durum*  $\times F_1$  beträgt die Zahl der 14- bzw. 21-chromosomigen Spermakerne 55 bzw. 17; diese zeigen bei *T. vulgare*  $\times F_1$  ungefähr die gleiche Anzahl. Es muss aber berücksichtigt werden, dass in ersterem Falle die zygotische Kombination der 14-chromosomigen Eizelle mit 21-chromosomigem Spermakern eine schlechtere Keimfähigkeit aufweist als die sich aus der Verbindung der 14-chromosomigen Eizelle mit 14-chromosomigem Spermakern ergebende. So waren im Kreuzungsversuch *T. durum*  $\times T. vulgare$  (Tab. 3) die Körner nur zu 35.14% keimfähig. Wenn wir die sich daraus ergebende Korrektur bei *T. durum*  $\times F_1$  ausführen, so erhalten wir nicht 17, sondern 48 ( $= 17/35.14\%$ ) 21-chromosomige Spermakerne gegen 55 14-chromosomige. Das Verhältnis der 14- und 21-chromosomigen Spermakerne ist also ungefähr das gleiche wie in der anderen Rückkreuzung *T. vulgare*  $\times F_1$ . Demnach können wir schliessen, dass der Unterschied der Zahlenreihen bei *T. durum*  $\times F_1$  und *T. vulgare*  $\times F_1$  im grossen und ganzen nicht auf der selektiven Befruchtung der 14- bzw. 21-chromosomigen Eizellen durch gleichchromosomige Spermakerne beruht, sondern auf der schlechteren Keimung der ersteren Rückkreuzung.

In der III. Mitteilung (KIHARA, WAKAKUWA u. YAMAMOTO, 1933) sind die Zahlenreihen bei *T. durum*  $\times F_1$  nicht J-förmig, sondern die Mode lag bei 14 (vgl. Tab. 2). Dies muss darauf beruhen, dass der Kreuzungserfolg in diesem Falle merklich niedriger war, als bei vorliegender Untersuchung und die 14-chromosomigen Eizellen durch minderchromosomige Spermakerne ziemlich selektiv befruchtet wurden. Das beruht aber in der Tat nicht auf der selektiven Befruchtung der Eikerne, sondern auf der Zertation der verschieden-chromosomigen Spermakerne. Bei *T. vulgare*  $\times F_1$  stellten sich die Ergebnisse der früheren und gegenwärtigen Untersuchungen fast nicht verschieden dar, indem die Kreuzungserfolge beider Untersuchungen natürlich ähnliche waren.

Auf die Berechnung des Verhältnisses der 14- und 21-chromosomigen Eizellen bei den Aequationskreuzungen (Tab. 6) müssen wir verzichten, da in diesen Versuchen keine einzige Befruchtung 21-chromosomiger Eizellen ein entwicklungsfähiges Korn ergeben hatte. Nach den Resultaten anderer Autoren in Tabelle 1 entspricht aber das Verhältnis ungefähr

dem von 10:1. In den männlichen Gonen muss, wie oben erwähnt, das gleiche Verhältnis herrschen. Auf Grund der Zertationskreuzungen wirkten jedoch die 14- und 21-chromosomigen Spermatkerne ungefähr in gleicher Anzahl befruchtend. In der Verbindung *T. durum*  $\times$  *T. vulgare* müsste danach die Befruchtungsfähigkeit der 21-chromosomigen Pollenkörner ungefähr 10 mal so gross sein wie die der 14-chromosomigen. Dieses Zahlenverhältnis stimmt mit den Resultaten von KIHARA (1932) in seinen Versuchen mit gemischten Pollen überein. Auf ähnliche Weise lässt sich die Befruchtungsfähigkeit der aneuploiden Pollenkörner erschliessen. Die am wenigsten tüchtigen Pollenkörner sind nämlich die mit intermediären Chromosomenzahlen (16 u. 17). Die gleiche Beziehung zwischen der Chromosomenzahl und der Befruchtungsfähigkeit der Pollenkörner wurde bereits bei der Verbindung *T. polonicum*  $\times$  *T. spelta* in der VI. Mitteilung beobachtet. Jedoch sind die höherchromosomigen Pollenkörner viel tüchtiger bei diesem Bastard *T. polonicum*  $\times$  *T. spelta* als diejenigen vom Bastard *T. durum*  $\times$  *T. vulgare*.

Bei reziproken Rückkreuzungen des Bastards *T. durum*  $\times$  *T. vulgare* zu beiden Eltern wurden die Beziehungen zwischen der Chromosomenzahl und der Entwicklung der Endospermen sowie der Anzahl der Tage bis zur Keimung der Körner festgestellt. Die Ergebnisse stimmen im grossen und ganzen mit denen der Verbindung *T. polonicum*  $\times$  *T. spelta* in der VIII. Mitteilung überein. Namentlich waren die Samen bei  $F_1 \times T. durum$  und *T. vulgare*  $\times F_1$  fast alle dickkörnig. Die Körnergrösse ist die kleinste bei den Endospermen mit gleicher Genomformel  $3(AB)+2D$ , wie bei  $F_1$ -Samen des Bastards *T. vulgare*  $\varphi \times T. durum$   $\sigma$ , im allgemeinen nehmen die Körner mit der Verminderung bzw. der Vermehrung der Chromosomenzahlen des D-Genoms in  $F_1 \times T. durum$  bzw. in *T. vulgare*  $\times F_1$  zu. Hingegen wurden viele schlanke und runzelige oder eingeschrumpfte Körner bei *T. durum*  $\times F_1$  und  $F_1 \times T. vulgare$  gewonnen. Die Zunahme der Runzeligkeit bei den Endospermen geht Hand in Hand mit dem Steigen der Anzahl der Dinkelchromosomen in der ersteren Verbindung bzw. ihrer Verminderung in der letzteren. Die Runzeligkeit der Körner mit heptaploiden Endospermen ( $3(AB)+D$ ) war am bemerkbarsten, ähnlich wie bei den Körnern der Kreuzung *T. durum*  $\varphi \times T. vulgare$   $\sigma$ .

Bei den Verbindungen  $F_1 \times T. durum$  und *T. durum*  $\times F_1$  ist zu erkennen, dass eine ziemlich positive Korrelation zwischen der Chromosomenzahl und der Zeitdauer bis zur Keimung der Körner besteht, während die Kreuzungen  $F_1 \times T. vulgare$  und *T. vulgare*  $\times F_1$  deutlich keine solche Korrelation konstatieren lassen. Je runzeliger oder je kleiner die Körner sind, desto später dürfte demnach die Keimung auftreten. In der Rückkreuzung des Bastards *T. polonicum*  $\times$  *T. spelta* war dagegen die Keimung der Körner unabhängig von ihrer Grösse (vgl. VIII. Mitt.).

### Zusammenfassung

1. Die Häufigkeit der verschiedenenchromosomigen Gonen des pentaploiden Bastards *Triticum durum* DESF. var. *Reichenbachii* KÖRN.  $\times$  *T. vulgare* VILL. var. *erythrospERMum* KÖRN. wurde auf Grund reziproker Rückkreuzungen mit beiden Eltern untersucht.

2. Die aus den Aequationskreuzungen gewonnene Zahlenreihe der 14- bis 21-chromosomigen Eizellen stimmt im grossen und ganzen mit den theoretischen Reihen, bei Annahme einer stärkeren Univalentenelimination (auf Grund der Formel  $(0.675 + 0.325)^7$ ) als derjenigen in der Verbindung *T. polonicum*  $\times$  *T. spelta* der IV. Mitteilung, überein (Tab. 6 u. Abb. 2 u. 3).

3. Auf Grund der Zertationskreuzungen tragen in der Hauptsache die euploiden Pollenkörner zur Befruchtung bei, während diejenigen mit intermediären Chromosomenzahlen viel weniger tüchtig sind (Tab. 9 u. Abb. 4 u. 5). Die höherchromosomigen Pollenkörner des Bastards *T. durum*  $\times$  *T. vulgare* sind tauglicher als die minderchromosomigen. Dieses Verhältnis ist aber nicht so stark wahrnehmbar, dass es beim Bastard *T. polonicum*  $\times$  *T. spelta* in der VI. Mitteilung beobachtet werden konnte.

4. Die Elimination der Zygoten, die aus der Verschmelzung von (14–17)-chromosomigen Eizellen mit 21-chromosomigen Spermakernen bei  $F_1 \times T. vulgare$  bzw. von 14-chromosomigen Eizellen mit (18–21)-chromosomigen Spermakernen bei *T. durum*  $\times$   $F_1$  gebildet werden, spielt infolge mangelhafter Keimung eine grosse Rolle für die Häufigkeit der verschiedenchromosomigen Pflanzen.

5. Bei diesen Aequations- und Zertationskreuzungen wurden die Beziehungen zwischen der Chromosomenzahl und der Entwicklung der Endospermen sowie der Zeitdauer bis zur Keimung der Körner festgestellt. Die Ergebnisse stimmen im grossen und ganzen mit denen des Bastards *T. polonicum*  $\times$  *T. spelta* in der VIII. Mitteilung überein.

Diese Untersuchungen wurden unter Leitung von Herrn Prof. Dr. H. KIHARA ausgeführt, dem ich auch an dieser Stelle meinen herzlichen Dank aussprechen möchte.

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# Die Mitwirkung der Stomata-Nebenzellen auf die Spaltöffnungsbewegung

Von Masami MONZI

Mit 8 Textfiguren und 11 Tabellen

(Eingegangen am 26. Dezember 1938)

## I. Einleitung

Schon im Jahre 1856 betonte VON MOHL sehr deutlich in seiner klassischen Abhandlung die Mitwirkung der den Schliesszellen benachbarten Epidermiszellen bei der Spaltöffnungsbewegung, d.h. dass „die Oeffnung und Schliessung der Spaltöffnungen nicht von der Thätigkeit der Porenzellen allein abhängt, sondern dass zwischen diesen und den Epidermiszellen ein Antagonismus existiert“. Später sah BENECKE (1892) nach seinen anatomischen Untersuchungen die Nebenzellen der Spaltöffnungen nicht nur als Mitarbeiter, sondern vielmehr als Schutzeinrichtung für die Schliesszellen gegen das Blattwelken an. Seitdem haben aber DARWIN (1904), DARWIN u. PERTZ (1911), LAIDLAW u. KNIGHT (1916), KNIGHT (1917, 1922), STEINBERGER (1922), STRUGGER u. WEBER (1926), WEBER (1927), STÄLFELT (1927, 1929) u. A. von einander unabhängig die Richtigkeit der MOHLschen Ansicht bestätigt. Unter ihnen verdient die Arbeit von STÄLFELT (1929) besondere Aufmerksamkeit. Er unterschied den Reaktionsmechanismus der Stomata in drei verschiedene, nämlich passive, photoaktive und hydroaktive Reaktionssysteme, und erörterte ausführlich die Mitwirkung der Neben- und Epidermiszellen in dem ersteren Reaktionssystem. Durch Untersuchungen über die Spaltöffnungsbewegung des *Fatsia*-Blattes zur Regenzeit (1938a) und bei Wasserzufuhr-Regulation (1938b) kam mir selbst auch derselbe Gedanke.

Diese Ansicht scheint mir aber nicht ganz einwandfrei zu sein, weil die Grundgedanken nur auf einem schwachen Fundamente beruhen, nämlich auf dem anfänglichen Spalten-Öffnen des welkenden Blattes (DARWIN, KNIGHT, WEBER, MONZI u. A.), ferner auf dem plötzlichen Spalten-Schliessen des unter Wasser getauchten (MOHL, STEINBERGER, STÄLFELT, MONZI u. A.), oder durch Wasserzufuhr wiederbelebten Blattes

(KNIGHT, MONZI u. A.), während es gänzlich an einer direkten Bestätigung über den Mitwirkungsmechanismus der Neben- und Epidermiszellen fehlt. Daher dürfte es besonders erforderlich sein, sowohl an den Schliesszellen, als auch an den benachbarten Zellen, über die die Spaltöffnungsbewegung begleitende Form- und Volumen-Veränderung jeder Zelle eine eingehende Untersuchung anzustellen.

In vorliegender Arbeit bestrebt ich mich daher besonders, die oben besagte Aufgabe zu lösen, und es ist mir gelungen, durch die Untersuchung der den Schliesszellen antagonischen Zu- oder Abnahme der Nebenzellenweite die Mitwirkung dieser Zellen bei der Spaltöffnungsbewegung zu konstatieren.

## II. Methodik und Versuchsmaterial

Das Blatt von *Commelina communis* L. wählte ich als Versuchsmaterial. Dasselbe war wegen der grossen Zellen des Spaltöffnungsapparates und der leicht abziehbaren Epidermis für meinen Versuchszweck sehr geeignet. Das Blatt ist amphistomatisch, aber an der Oberseite befinden sich nur spärliche Stomata. Daher führte ich meine Versuche stets an den Stomata der Blattunterseite aus. Die Spaltöffnungen liegen, wie es an den Blättern von Monokotylen-Pflanzen allgemein ist, mit den Blatt-Nerven parallel.

Der Spaltöffnungsapparat der Versuchspflanze besteht, wie in Fig. 1 gezeichnet, aus einem Paar Schliesszellen, und drei Paaren Nebenzellen, nämlich den vor und hinter den Schliesszellen liegenden Polar-Nebenzellen, und den an der Aussenseite der Schliesszellen liegenden Innen- und Aussen-Nebenzellen. Die Schliesszellen haben eine an den pflanzlichen Stomata im allgemeinen vorkommende Gestalt. Der Vor- und Hinterhof entwickeln sich ziemlich gut. Die Bauch- und besonders die Rückwand der Zellen sind dünn, aber die Aussen- und Innen-Zellwand ziemlich dick. Von diesen Zellwänden umgeben ist ein im Querschnitt dreieckiger Raum, dessen Höhe, wie aus Tab. 1 ersichtlich, beträchtlich kleiner als seine Weite ist. Die Innen-Nebenzellen sind stets länglich gestaltet, und stehen mit ihrer Achse quer zur Epidermisfläche, während die Aussen-Nebenzellen ebenfalls länglich, aber mit ihrer Achse parallel zur Epidermisfläche angeordnet sind (vgl. Tab. 1). Um den Spaltöffnungsapparat kommt die

TABELLE 1. Die Weite und Höhe der Epidermiszelle, Aussen- und Innen-Nebenzelle, und Schliesszelle. (Das Mittel der 20 Spaltöffnungen)

	Epidermiszelle	Aussen-Nebenzelle	Innen-Nebenzelle	Schliesszelle
Weite	68,1 $\mu$	30,4 $\mu$	10,2 $\mu$	12,0 $\mu$
Höhe	54,2 $\mu$	20,8 $\mu$	19,4 $\mu$	9,9 $\mu$

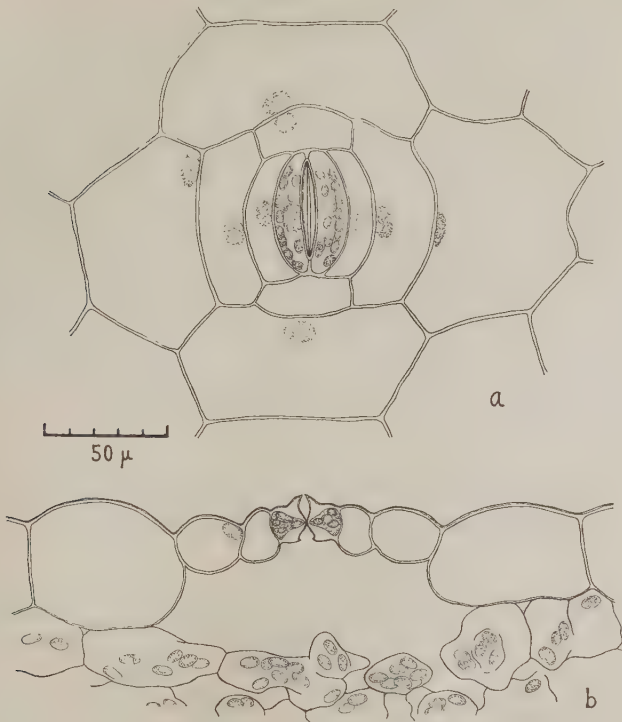


Fig. 1. Der Spaltöffnungsapparat von *Commelina communis*.  
a. Oberflächenansicht. b. Querschnitt.

normale Epidermiszelle. Sie ist gewöhnlich weit grösser im Vergleich mit den oben beschriebenen Zellen: Ihre Weite kommt öfters der des ganzen Spaltöffnungsapparates gleich, und die Höhe ist zwei oder dreimal so gross wie die der Stomata-Zellen (vgl. Tab. 1). Die Mesophyll-Zellen haften an der Innen-Wand der Epidermiszellen; daher kommt eine grosse Atemhöhle unter dem Spaltöffnungsapparat vor. Eine sehr dünne Kutikular-Schicht bedeckt die ganze Oberfläche der Blattunterseite.

Am Vorabend des Versuchstages schnitt ich eine Freiland-Sprosse von *Commelina* mit zwei oder drei völlig entwickelten Blättern unter Wasser ab. Dann wurde sie in den Versuchsraum gebracht und bis zum Versuche, unter einer Glasglocke durch das Schnittende des Stengels mit Wasser versehen, in feucht-dunklem („Feucht-Dunkel“) Zustand erhalten, oder entsprechend dem Versuchszweck unter einer mit Wasserdampf fast gesättigten Glasglocke in diffuses Tageslicht („Feucht-Licht“) verbracht, da die von der Wurzel getrennte Sprosse ohne Zufuhr von

Wasser und Hemmung der Transpiration zu schnell welkt, um eine genaue Untersuchung des Mechanismus der Spaltöffnungsbewegung zu gestatten. Dank dieser Massnahme standen mir nach Belieben Objekt mit völlig geschlossenen oder auch weit geöffneten Spaltöffnungen zur Verfügung.

Die Weite der Spalten, Schliesszellen und Nebenzellen bestimmte ich genau in kurzen Zeitabständen mit Hilfe eines Okular-Mikrometers an einem mit einer Pinzette schnell abgezogenen Epidermisstreifen. Um das Vorhandensein eines auf die Schliesszellen von aussen wirkenden Seitendruckes und die Mitwirkung von Nebenzellen bei der Spaltöffnungsbewegung zu ermitteln, bediente ich mir einiger verschiedenartiger Versuchsmethoden, z.B. der Zuckerlösungs- und Mikromanipulator-Methode; diesbezügliche, ausführliche Beschreibungen beabsichtige ich später in eigenen Abschnitten zu geben. Die Untersuchungen wurden meistens in einer Lufttemperatur von 25°–30°C ausgeführt.

### III. Der Seitendruck der Nebenzellen und die durch Beseitigung desselben verursachte Öffnung der Spalte

Um die Mitwirkung der Nebenzellen auf die Spaltöffnungsbewegung zu konstatieren, muss man untersuchen erstens, ob die Nebenzellen seitlich die Schliesszellen positiv so stark drücken können, dass deren Spalte unter diesem Drucke sich nicht öffnen kann; zweitens, ob jede benachbarte Zelle, d.h. Innen- und Aussen-Nebenzelle und Epidermiszelle, hierbei einen gleich starken oder einen verschiedenen Einfluss ausübt, und letzts, ob bei Beseitigung des auf die Schliesszellen wirkenden Seitendrucks die geschlossenen Spaltöffnungen sich wieder öffnen können oder noch geschlossen bleiben müssen. Diese Probleme konnte ich durch drei Versuche, nämlich Rand-, Zuckerlösungs- und Mikromanipulator-Versuch ziemlich leicht lösen.

#### (1) Rand-Versuch

Am Rand des mit der Pinzette abgezogenen Epidermisstreifens können wir einen Spaltöffnungsapparat wahrnehmen, an dem einige seiner eigenen oder benachbarten Zellen durch den beim Abziehen entstandenen Riss beschädigt wurden. Zur mikroskopischen Untersuchung gebrauchte ich den gleich nach Abziehen von der Unterseite des „Feucht-Dunkel“-Blattes mit Wasser versehenen Epidermisstreifen.

An einem in der Mitte des Epidermisstreifens sich befindenden, nicht beschädigten Spaltöffnungsapparat (Tab. 2, A; Fig. 2, A) sind die Schliesszellen ganz schmal, und die Spalte ist völlig geschlossen. Die



Innen-Nebenzellen desselben sind weit ausgedehnt. Das mikroskopische Bild sowohl des nur die Epidermiszelle verloren habenden Spaltöffnungsapparates (Tab. 2, B), als auch jenes, an dem auch die Aussen-Nebenzelle beschädigt ist (Tab. 2, C), ist nicht so verschieden von dem Bilde des unbeschädigten Spaltöffnungsapparates. Verschieden dagegen ist das Bild desjenigen Spaltöffnungsapparates, der eine von den Innen-Nebenzellen verloren hat (Tab. 2, D; Fig. 2,D). Die Schliesszelle, deren Innen-Nebenzelle verletzt ist, krümmt sich nach aussen, d.h. nach der Seite der

TABELLE 2. Die Weite der Schliess-, Neben- und Epidermiszellen. Erklärung im Text. (Das Mittel der ca. 20 Spaltöffnungen)

	Epid.	Auss-N.	Inn-N.	Schl.	Spalte	Schl.	Inn-N.	Auss-N.	Epid.
		$\mu$	$\mu$	$\mu$	$\mu$	$\mu$	$\mu$	$\mu$	
A	+	29,8	15,6	13,4	0,0	13,0	16,8	30,4	+
B	+	30,0	15,7	13,1	0,1	13,2	15,9	30,5	—
C	+	30,4	16,8	13,3	0,2	13,4	17,1	—	—
D	+	29,8	16,4	13,1	2,8	16,7	—	—	—
E	+	30,3	14,6	14,5	—	—	—	—	—
F	—	—	—	16,1	6,3	16,1	—	—	—

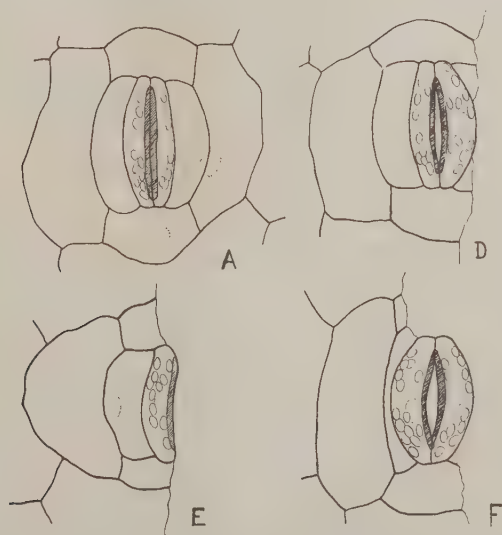


Fig. 2. Oberflächenansicht der normalen (A) und der die Nebenzellen verloren habenden Spaltöffnungsapparate (D,E,F). Vgl. Tab. 2 und den Text.

verletzten Nebenzelle, mit Weiten-Zunahme, dann tritt die Öffnung der Spalte zwischen dieser und der anderen, noch die lebende Innen-Nebenzelle aufweisenden Schliesszelle ein. Jene Schliesszelle, die durch den Riss von ihrer gegenüberliegenden Schliesszelle getrennt wurde, und deren eigene Nebenzelle noch unversehrt ist, krümmt sich nach der Rückseite nur wenig (Tab. 2, E; Fig. 2, E). Die von den benachbarten Zellen ganz isolierten, stark erweiterten Schliesszellen weisen zwischen sich eine weite Öffnung der Spalte auf (Tab. 2, F; Fig. 2, F).

## (2) Zuckerlösungs-Versuch

Auf einen schon unter Mikroskop vorbereiteten Epidermisstreifen 1 mol. Rohrzuckerlösung giessend, machte ich ihn plasmolisieren, und verglich die Weite jeder Zelle des Spaltöffnungsapparates vor und nach der Plasmolyse mit einander. Infolge der Plasmolyse nimmt die Weite der mit gesunden Nebenzellen ausgerüsteten Schliesszelle ziemlich zu (vgl. Tab. 3, A; Fig. 3), und dabei verschmälert sich die Innen-Nebenzelle.

TABELLE 3. Die durch Plasmolyse verursachte Weiten-Änderung der Schliesszellen sowie Innen- und Aussen-Nebenzellen. Vgl. den Text. (Das Mittel der 10 Spaltöffnungen)

	Plas- molyse	Epi.	Auss-N.	Inn-N.	Schl.	Spalte	Schl.	Inn-N.	Auss-N.	Epi.
		+	$\mu$	$\mu$	$\mu$	$\mu$	$\mu$	$\mu$	$\mu$	+
A	Vor	+	30,5	16,7	12,8	0,0	12,6	15,8	30,8	+
	Nach	+	31,0	14,1	14,9	0,2	14,5	13,8	31,1	+
D	Vor	+	30,3	16,4	12,6	3,5	16,6	—	—	—
	Nach	+	31,0	13,5	15,7	0,4	16,0	—	—	—

Aber die Schliesszelle, deren Innen-Nebenzelle beschädigt wurde, nimmt an Weite ab, wenn auch nur schwach (vgl. Tab. 3, D).

Der osmotische Wert der Schliesszelle des „Feucht-Dunkel“-Blattes von *Commelina* ist nach meiner Plasmolyse-Messung mit Glykoselösung um etwa 0,1 mol höher als der der benachbarten Zellen, weil die Grenzplasmolyse gewöhnlich an der ersteren erst in 0,25 mol. Lösung, und an den letzteren schon in 0,15 mol. Lösung in Erscheinung kommt. Infolge dieser osmotischen Differenz möchte es möglich sein, dass man durch Wasser-Entzug vom Epidermisstreifen mit einer geeignet konzentrierten Zuckerlösung den auf die Schliesszellen wirkenden Seitendruck der benachbarten Zellen, ohne völliges Verschwinden des Turgordruckes der Schliesszellen selbst, beseitigt, sodass die geschlossene Spalte sich also künstlich öffnen lässt.

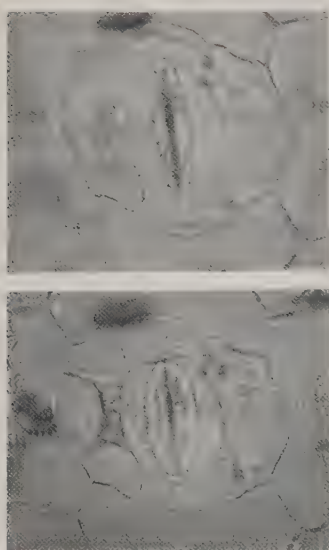


Fig. 3. Ein dunkel-geschlossener Spaltöffnungsapparat von *Comelina* (oben) und derselbe nach Plasmolyse mit 1 mol. Rohrzuckerlösung (unten).

Diesbezügliche Untersuchungen führte ich, wie folgt, aus: Ich benützte der Reihe nach mehrere Epidermisstreifen von der Unterseite des „Feucht-Dunkel“-Blattes. Sobald ich einen davon abgezogen hatte, tauchte ich ihn auf einem Objektträger in einen Tropfen Rohrzuckerlösung und untersuchte ihn sofort im Mikroskop. Ich gebrauchte dazu eine Rohrzuckerlösungsreihe, deren Konzentrationsstufe 0,025 und 0,05 mol war. Jedesmal suchte ich schnell einen normal gebildeten Spaltöffnungsapparat zur Beobachtung der die Spaltöffnungsbewegung begleitenden Weiten-Veränderungen der Zellen. Nach einigen dieser Versuchsergebnisse habe ich hier Fig. 4 gezeichnet.

Im Wasser nimmt die Weite der Schliesszellen schwach ab, die der Innen-Nebenzellen nimmt dagegen schwach zu, und die Spalte bleibt von Anfang bis zu Ende des Versuches ganz geschlossen (Fig. 4 a). In unter-optimal osmotischer Lösung (0,05–0,15 mol) tritt zuerst eine Erweiterung der Schliesszellen und die antagonische Schrumpfung der Innen-Nebenzellen ein. Erst etwa 5 Minuten nach Eintauchen beginnt die Spalte

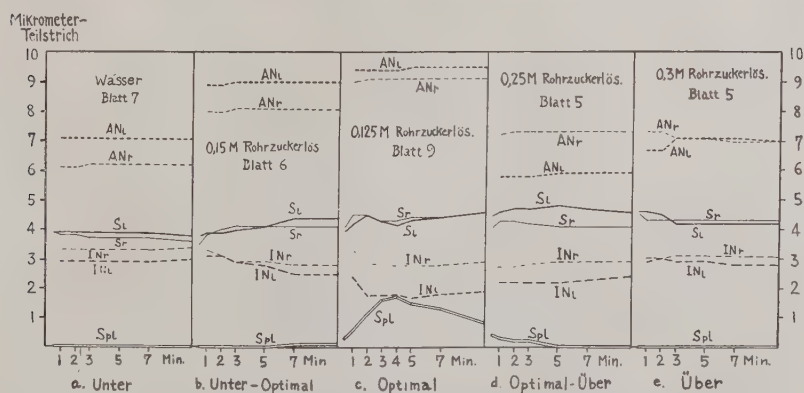


Fig. 4. Die durch Eintauchen in die Rohrzuckerlösung verursachte Spalten-Öffnung und Weiten-Änderung der Zellen. 1 Mikrometer-Teilstrich = 3,56  $\mu$ . — Spl = Spalte, — S = Schliesszelle, — IN = Innen-Nebenzelle, - - - - AN = Aussen-Nebenzelle, r = rechts (dünn), l = links (dick).

sich langsam zu öffnen (Fig. 4 b). In der optimal osmotischen Lösung (0,1–0,2 mol) öffnet sich die Spalte ziemlich weit, und die Schliesszellen sowie die Innen-Nebenzellen verändern mit fortschreitender Öffnungsbewegung wie in dem letzteren Fall ihre Weite antagonistisch noch mehr bzw. verringern sie. Wenn die Spalte maximal sich öffnet, pflegt eine schwache Weitenabnahme der Schliesszellen einzutreten (Fig. 4 c). Auf der maximalen Öffnung, die meistens etwa 5 Minuten nach Eintauchen stattfindet, folgt ein abermaliger Spalten-Verschluss. In optimal-über osmotischer Lösung (0,15–0,35 mol) schliesst sich die durch Eintauchen einmal geöffnete Spalte schon nach der ersten Minute des Versuches. Noch konzentriertere, über-osmotische Lösung (über 0,3 mol) bewirkt keine Spalten-Öffnung mehr. Die während der ersten Minute weit aufgespannten Schliesszellen nehmen an Weite allmählich ab (Fig. 4 e). Durch alle Versuche hindurch schwankte die Weite der Aussen-Nebenzellen im Vergleich mit der der Schliesszellen und Innen-Nebenzellen nur in so geringem Grade, dass sie keine Beachtung verdient.

Eine ähnliche Erscheinung berichtete schon WEBER (1930) bei Harnstofflösungs-Infiltration im *Ranunculus*-Blatt. Dabei entstand die Turgor-Differenz zwischen den Schliesszellen und den benachbarten Zellen durch die eigentümliche Permeabilität der ersteren für das Plasmolytikum. Dass die extrem geöffneten Stomata, die nach Harnstoff-Aufnahme ins Wasser übergelegt wurden, bei längerem Verweilen im Wasser endlich sich schlossen, erklärt er durch fortschreitende Exosmose des Harnstoffes aus den Schliesszellen, aber ich möchte als eine von den Ursachen dieses Spalten-Verschlusses den wiederauflebenden Turgor der benachbarten Zellen hervorheben.

### (3) Mikromanipulator-Versuch

Das Vorhandensein eines Seitendruckes der Nebenzellen konnte ich mit Hilfe des PÉTERFischen Mikromanipulators von ZEISS sehr klar bestätigen. Die Mikromanipulation nahm ich, wie folgt, vor: Von der Unterseite des „Feucht-Dunkel“-Blattes zog ich mit der Pinzette einen Epidermisstreifen ab. Dann klebte ich mit Wasser seine Aussenseite nach oben an die Unterseite des Deckglases einer kleinen Feuchtkammer oder des Objektträgers, sodass die Seite, an welcher er abgezogen wurde, nach unten in der feuchten Luft frei blieb. Unter Mikroskop konnte ich nun eine beliebige Zelle ohne Schädigung der anderen von unten mit einer spitzen Mikromanipulator-Nadel aufstechen. Der Inhalt der aufgestochenen Zelle floss durch den Riss, und dieselbe verlor ihren Turgordruck augenblicklich.

Sticht man zuerst eine Schliesszelle auf, so nimmt die Weite derselben schnell ab, die der Innen-Nebenzelle dagegen bedeutend zu (vgl. Tab. 4). Sticht man aber danach auch die letztere Zelle auf, so stellt die

TABELLE 4. Versuch M.35. Die durch Einstechen der Mikromanipulator-Nadel verursachte Weiten-Änderung der Stomata-Zellen. Die Werte sind in Okularmikrometer-Teilstrichen angegeben, wobei ein Strich  $3,18\mu$  entspricht. Die mit Klammern umgebenen Zahlen bedeuten die Weite der durch die Mikromanipulator-Nadel aufgestochenen und abgestorbenen Zellen

Aufgestochene Zellen	Auss-N.	Inn-N.	Schl.	Spalte	Schl.	Inn-N.	Auss-N.
	9,3	6,0	3,9	0,0	4,3	4,7	12,1
Schliesszelle (links)	9,5	6,5	(3,2)	0,0	4,3	4,7	12,1
„ (rechts)	9,5	6,5	(3,2)	0,0	(3,1)	5,7	12,3
Innen-Nebenzelle (rechts)	9,5	6,7	(3,1)	0,0	(4,8)	(3,6)	12,6
„ „ (links)	9,9	(4,7)	(4,6)	0,0	(4,9)	(3,7)	12,6

erschlafte Schliesszelle ihre Weite trotz dem Abnehmen der Weite der Innen-Nebenzelle wieder her. Während der Versuchszeit zeigt sich aber keine Öffnung der Spalte.

Unter anderem stellte ich auch mehrere Versuche an, wobei ich die Zellen des Spaltöffnungsapparates in der Reihenfolge Epidermiszelle-Nebenzelle-Schliesszelle, also von aussen nach innen, aufstach. Von diesen Untersuchungen möchte ich zunächst in Tab. 5 den Versuch M. 34 hervorheben.

TABELLE 5. Versuch M.34. Die durch Einstechen der Mikromanipulator-Nadel verursachte Weiten-Änderung der Stomata-Zellen, und die Öffnung der Spalte. 1 Mikrometer-Teilstrich =  $3,18\mu$ . Vgl. Tab. 4.

Aufgestochene Zellen	Auss-N.	Inn-N.	Schl.	Spalte	Schl.	Inn-N.	Auss-N.
	10,3	5,2	4,1	0,0	4,6	5,0	9,3
Epidermiszelle (rechts)	10,3	5,2	4,1	0,0	4,6	4,9	9,3
„ (links)	10,3	5,4	3,9	0,0	4,5	5,0	9,3
„ (vorne)	10,3	5,4	3,9	0,0	4,5	5,0	9,3
„ (hinten)	10,6	5,2	3,8	0,0	4,4	5,0	9,4
Polar-Nebenzelle (hinten)	10,6	5,2	3,8	0,0	4,4	5,0	9,4
Aussen- „ (links)	(10,1)	5,8	3,8	0,0	4,4	5,0	9,3
Polar- „ (vorne)	(10,1)	5,7	3,8	0,0	4,4	5,0	9,3
Aussen- „ (rechts)	(10,1)	5,7	4,0	0,0	4,5	5,0	(9,0)
Innen-Nebenzelle (rechts)	(10,2)	5,6	4,2	0,4	5,5	(3,1)	(9,3)
„ „ (links)	(10,7)	(4,0)	5,0	0,7	5,5	(3,1)	(9,3)
Schliesszelle (links)	(10,9)	(4,4)	(4,9)	0,2	5,5	(3,1)	(9,3)
„ (rechts)	(10,9)	(4,3)	(4,8)	0,0	(5,0)	(3,8)	(9,5)



Das Aufstechen der Epidermiszelle und der Polar- und Aussen-Nebenzellen hat auf die Schliesszellen fast keinen oder keinen Einfluss. Die Spalte bleibt geschlossen. Aber, wenn die Innen-Nebenzelle aufgestochen wird, so spannt sich die Schliesszelle nach der Rückseite stark, und tritt eine Öffnung der Spalte ein. Die aufgestochene Innen-Nebenzelle wird dabei freilich zusammengedrückt. Zuletzt, wenn die Schliesszelle selbst aufgestochen wird, schliesst sich die künstlich geöffnete Spalte gleichzeitig mit dem Schwinden ihres Turgordrucks.

Sticht man die Innen-Nebenzellen allein auf, so treten auch das Öffnen der ganz geschlossenen Spalte und ein Weitenzunahme der Schliesszellen ein, wobei der Turgordruck der anderen Nebenzellen und der Epidermiszellen bestehen bleibt (vgl. Tab. 6, Fig. 5).

TABELLE 6. Versuch M.36. Das durch Aufstechen der Innen-Nebenzellen verursachte Öffnen der geschlossenen Spalte des „Feucht-Dunkel“-Blattes.  
1 Mikrometer-Teilstrich = 3,18 $\mu$ . Vgl. Tab. 4.

Aufgestochene Zellen	Auss-N.	Inn-N.	Schl.	Spalte	Schl.	Inn-N.	Auss-N.
	9,5	4,6	4,3	0,0	3,7	5,0	10,7
Innen-Nebenzelle (links)	9,7	(2,8)	5,3	0,2	3,9	5,2	10,7
„ „ (rechts)	9,6	(2,9)	5,3	0,8	5,1	(3,2)	10,9

Aus den oben beschriebenen Versuchsergebnissen können wir einwandfrei schliessen: Die Schliesszelle wird an der im Feucht-Dunkel geschlossenen Spaltöffnung von den benachbarten Zellen, besonders von der Innen-Nebenzelle seitlich stark gedrückt. Wird daher der Seitendruck aufgehoben, so spannt sich die Schliesszelle augenblicklich stark nach ihrer Rückseite und zeigt an ihrer Bauchseite eine Öffnung der Spalte. Die Innen-Nebenzelle ändert beim Öffnen der Spalte fast stets ihre Weite antagonistisch gegenüber derjenigen der Schliesszelle; aber die Polar- und Aussen-Nebenzellen und die normalen Epidermiszellen stehen zur Spaltöffnungsbewegung fast in keiner unmittelbaren Beziehung.

#### IV. Das Öffnen der Spalten des unverletzten Blattes

An dem Spaltöffnungsapparate des abgezogenen Epidermisstreifens konnte ich, wie oben erwähnt, die Mitwirkung der Nebenzellen klar feststellen, aber es besteht für mich weiterhin das Problem, ob die Schliesszelle und die Innen-Nebenzelle des unverletzten Blattes, wie am Epidermisstreifen beobachtet, mit Öffnen der Spalte ihre Weite antagonistisch tatsächlich verändern können.

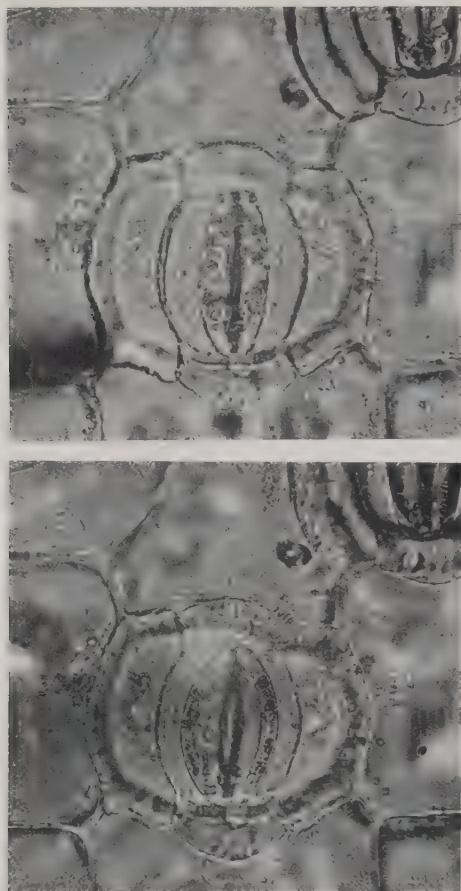


Fig. 5. Ein dunkel-geschlossener Spaltöffnungsapparat von *Commelina*. Oben: Vor dem Behandlung. Unten: Nach dem Aufstechen der beiden Innen-Nebenzellen mit Mikromanipulator-Nadel. Vgl. den Text und Tab. 6.

Ohne Abschneiden oder Zerschneiden brachte ich ein ganzes „Feucht-Dunkel“-Blatt mit der Unterseite nach oben den Objektisch eines Mikroskops, und drückte die beiden Enden leicht mit Federklammern, um das Versuchsblatt festzuhalten. Das Blatt wurde von unten durch das abgeschnittene Ende des Stengels mit Wasser versehen, da es, ohne Wasserversorgung in der Luft befindlich, zu schnell welkt, um die Spalten noch öffnen zu können. Die Weite der Spalte und jeder Zelle der Spaltöffnungs-

apparates konnte ich ohne weiteres Hilfsmittel durch Belichtung von unten mit diffusem Tageslicht allein ziemlich leicht bestimmen.

Zuerst nimmt die Weite der Schliesszelle zu, die der Innen-Nebenzelle dagegen ab. Etwa 10 oder 15 Minuten nach dem Herausbringen aus der Glasglocke beginnt die Spalte sich zu öffnen, um sich allmählich zu erweitern. Gleichzeitig mit der maximalen Weite der Schliesszellen und der minimalen der Innen-Nebenzellen erreicht sie ihre maximale Öffnung. Darauf folgt eine neue Schliessbewegung der Spalte. Die Weite der Aussen-Nebenzellen pflegt mit fortschreitenden Eintrocknen des Blattes zuzunehmen, aber der Schwankungsbereich ist im Vergleich mit dem der oben erörterten Zellen sehr klein (vgl. Tab. 7).

TABELLE 7. Versuch B.19. Das durch Übertragen in trockene Luft verursachte Öffnen der Spalte des unverletzten Blattes und die dabei vorkommende Weiten-Änderung der Zellen. 1 Mikrometer-Teilstrich = 3,56 $\mu$ .  
Am 15. Aug. Trübes Wetter.

Min.	Auss-N.	Inn-N.	Schl.	Spalte	Schl.	Inn-N.	Auss-N.	Uhr	Luft-temp.	Psy-Diff.
1	9,5	4,0	4,0	0,0	3,8	4,1	8,9	10,20	23,2°	2,9°
3	9,5	4,0	4,0	0,0	3,8	4,1	8,9			
5	9,6	4,0	4,0	0,0	3,9	4,0	8,9			
10	9,7	3,2	4,6	0,4	4,8	3,0	8,8	10,30	29,1°	3,4°
13	9,9	2,8	4,3	1,0	5,0	2,7	9,1			
16	10,0	2,8	4,2	1,2	4,8	2,7	9,1			
20	10,1	2,8	4,2	0,8	4,4	3,1	9,2	10,40	29,5°	3,7°
25	10,0	3,3	4,0	0,2	4,5	3,3	9,2			
30	10,0	3,4	3,9	0,0	4,2	3,8	9,0	10,50	29,4°	3,7°

Nach diesem Versuchsergebnis zu urteilen, ist es von vornherein klar, dass die Schliesszelle und die benachbarten Zellen des unverletzten Blattes, wie schon an den Stomata des in Zuckerlösung getauchten Epidermisstreifens ausführlich untersucht, mit Öffnen der Spalten, das durch Wasserverlust des Blattes verursacht wird, ihre Weiten und Formen verändern, oder anders gesagt, dass für das Öffnen der Spalten die Spannung der Schliesszellen und die antagonische Schrumpfung der Innen-Nebenzellen vorläufig immer notwendig sind.

## V. Das plötzliche Schliessen der Spalten durch Wasserzufuhr

Der durch plötzliche Zunahme des Blatt-Wasservorrates herbeigeführte Verschluss der geöffneten Stomata wurde schon durch VON MOHL (1856), STEINBERGER (1922), STÄLFELT (1929), MONZI (1938) u. A.

manchmal erörtert. Diese Erscheinung weckte bei den genannten Autoren den Gedanken an eine Mitwirkung der Nebenzellen. Aber es sind noch keine genauen Ermittlungen über die damit verursachte Volumen-Veränderung der Schliesszelle und der benachbarten Zellen angestellt worden.

Sogleich als ich einen Epidermisstreifen vom „Feucht-Licht“-Blatt abgezogen hatte, bestimmte ich die Weite der Spalte und jeder Zelle mikroskopisch. Danach tröpfelte ich ein Wassertröpfchen auf den Streifen, wobei ich darauf achtete, dass sich die Versuchs-Spaltöffnung stets im Gesichtsfeld des Mikroskops befand. Die anfänglich in der Luft weit geöffnete Spalte fing unter Wasser an, sich zu schliessen. Die ganz eng zusammengeschrumpften Innen-Nebenzellen nahmen an Weite plötzlich zu, und die stark erweiterten Schliesszellen verengerten sich umgekehrt rasch. Die minimale Weite der Schliesszellen pflegt am Anfang der Spalten-Schliessung einzutreten. Diese Schliessbewegung geht so schnell vor sich, dass die Spalten schon 15 Minuten oder wenig mehr nach der

TABELLE 8. Versuch W.4. Der durch Begiessen mit Wasser verursachte Spalten-Verschluss und die dabei eintretende Weitenänderung der Zellen.

1 Mikrometer-Teilstrich = 3,56 $\mu$ .

Min.	Auss-N.	Inn-N.	Schl.	Spalte	Schl.	Inn-N.	Auss-N.
1	9,2	2,1	5,1	2,8	5,7	1,9	11,4
2	9,2	2,1	5,1	2,8	5,7	1,9	11,4
Begiessen							
3	9,2	3,5	4,6	1,1	4,8	3,6	11,4
4	9,2	3,9	4,7	0,9	4,6	3,8	11,1
6	9,2	3,9	4,8	0,8	4,6	3,8	11,1
8	9,1	4,0	4,8	0,5	4,8	3,9	11,0
10	9,1	4,1	4,8	0,3	4,9	4,0	10,9
15	9,1	4,7	4,3	0,1	4,8	4,2	10,9
20	9,1	4,9	4,2	0,1	4,7	4,2	10,9

TABELLE 9. Versuch S.4. Der Spalten-Verschluss ohne Änderung der Stärkekörner in der Schliesszelle bei 30 Minuten dauerndem Eintauchen in Wasser.  
(Das Mittel der 10 Spaltöffnungen)

	9,30 Uhr				10,00 Uhr (Im Wasser 30 Min.)			
	Spalte	Schliess.	Inn-N.	Auss-N.	Spalte	Schliess.	Inn-N.	Auss-N.
Weite	7,2 $\mu$	18,7 $\mu$	5,6 $\mu$	31,6 $\mu$	0,2 $\mu$	16,6 $\mu$	13,7 $\mu$	31,2 $\mu$
Stärke (Durchm. Zahl)	—	3,83 $\mu$ 12,5	—	—	—	3,86 $\mu$ 12,4	—	—



Wasserzufuhr fast oder ganz völlig geschlossen sind. Die Weite der Aussen-Nebenzellen nimmt nur wenig ab (Vgl. Tab. 8, Fig. 6).

Dieser Spalten-Verschluss ist, wie ich am *Fatsia*-Blatt früher beobachtete (1938b), von keiner Änderung der Stärke-Menge in den Schliesszellen begleitet. Den Versuch führte ich, wie unten beschrieben, aus, und stelle dessen Protokoll in Tab. 9 zusammen. Von der Unterseite eines „Feucht-Licht“-Blattes zog ich einige Epidermisstreifen ab. Als bald tauchte ich die Hälfte der Anzahl ins Wasser, ein Viertel in Jodjodkali-lösung, um die Stärkemenge zu bestimmen, und das übrige Viertel in absoluten Alkohol, um die Weite der Spalte und die jeder Zelle zu messen. Die ins Wasser getauchten Epidermisstreifen verbrachte ich nach einiger Zeit zur Bestimmung der Stärkemenge bzw. Spalt- und Zellweite teils in Jodjodkalilösung, teils in absoluten Alkohol. Die Stärkemenge beurteilte ich hier nach der Zahl und dem Durchmesser der Stärkekörner, die in einer Schliesszelle vorhanden waren.

Auf Grund der oben dargebotenen Versuchsergebnisse können wir vermuten, dass die Innen-Nebenzellen durch Wasser-Einsaugung ihren Turgordruck wiedererlangten, und mit zunehmender Kraft die Schliesszellen seitlich stark drücken können, sodass infolgedessen eine Verengung der Schliesszellen und der Verschluss der Spalte ohne Katatonose der Stärke in den Schliesszellen eintreten. Aber diese Annahme

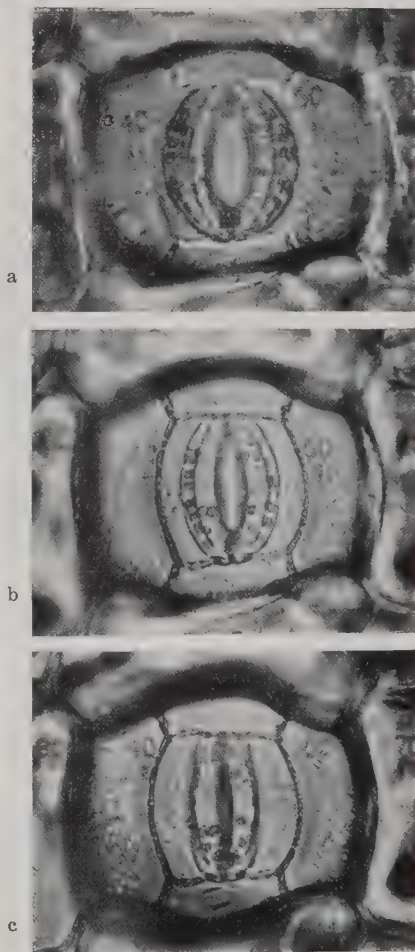


Fig. 6. Der durch Begiessen mit Wasser verursachte Spalten-Verschluss. 8,30 Uhr 9,30 Uhr belichtet.

- a. 2 Min. nach Abziehen (Ohne Wasserversorgung).
- b. 6 Min. nach Abziehen; 3 Min. nach Begiessen mit Wasser.
- c. 10 Min. nach Abziehen; 7 Min. nach Begiessen mit Wasser.

(Vgl. Tab. 8 und den Text)



dürfte nicht völlig einwandfrei sein, weil noch gar nicht feststeht, ob ohne Mitwirkung der lebenden Nebenzellen, also durch die eigene Wirkung der Schliesszellen allein, der Verschluss der Spalte bzw. die Weiten-Abnahme der Schliesszellen bei der plötzlichen Wasserzufuhr nicht hervorgerufen werden können. Um diesen Einwand zu beseitigen, wandte ich hier auch die Mikromanipulator-Methode an (vgl. Tab. 10, und Fig. 7).

TABELLE 10. Versuch M.53. Die durch Aufstechen und Begiessen mit Wasser verursachte Weiten-Änderung der Spalte und der Zellen. Das Versuchsblatt wird 9,40 Uhr – 11,00 Uhr belichtet. 1 Mikrometer-Teilstrich = 3,18 $\mu$ . Vgl. Tab. 4

Min.	Bemerkung	Auss-N.	Inn-N.	Schl.	Spalte	Schl.	Inn-N.	Auss-N.
0	Abziehen							
4		10,8	2,1	5,9	2,9	5,4	2,1	9,1
6	Aufstch. d. Inn-N(l)		×					
7		10,9	(1,5)	6,0	2,9	5,6	2,1	9,3
10	Begiessen m. Wasser							
11		10,7	(2,3)	6,0	1,8	5,1	3,1	9,2
16		10,7	(2,4)	5,9	0,9	4,9	4,3	9,1
24		10,7	(2,4)	5,9	0,3	4,5	5,3	9,0
25	Aufstch. d. Inn-N(r)						×	
26		11,0	(2,7)	5,4	1,6	5,0	(3,4)	9,1

In gleicher Weise wie in dem früher erwähnten Fall, aber diesmal ohne Wasserversorgung, klebte ich einen Epidermisstreifen des „Feucht-Licht“-Blattes an das Deckglas des Objektträgers. Nach der Messung der Spalte und jeder Zelle (Fig. 7a) stach ich von unten mit einer Mikromanipulator-Nadel die eine der Innen-Nebenzellen auf (Fig. 7b). Danach versorgte ich denselben Streifen von unten mittels einer Pipette mit Wasser, ohne die betreffende Spaltöffnung aus dem Auge zu verlieren. Dabei nahm die andere, nicht aufgestochene Innen-Nebenzelle, wie bei dem vollkommenen Spaltöffnungsapparat analog schon beobachtet, an Weite zu, die Schliesszelle aber im Gegenteil ab. Die aufgestochene Innen-Nebenzelle und deren Schliesszelle behielten jedoch dieselbe Form des Öffnungs-Zustandes fast über die ganze Versuchszeit bei. Daher trat ein künstlicher unsymmetrischer Spaltöffnungsapparat in Erscheinung. Die eine der Schliesszellen, deren Innen-Nebenzelle aufgestochen ward, hatte eine grosse Weite und krümmte sich nach der Rückseite, die andere, deren Innen-Nebenzelle noch lebend war, streckte sich bei schmaler Breite ganz gerade: zwischen beiden Schliesszellen befand sich eine halbmondförmige Spalte (Fig. 7c). Zuletzt stach ich die noch lebende, weit erweiterte Innen-Nebenzelle auf. Ihre Schliesszelle nahm alsbald an Weite

plötzlich zu und spannte sich nach aussen; daher kehrte die Spalte wieder in symmetrische Linsenform zurück (Fig. 7d). Diesbezüglich wiederholte Versuche führten stets zu denselben Resultaten.

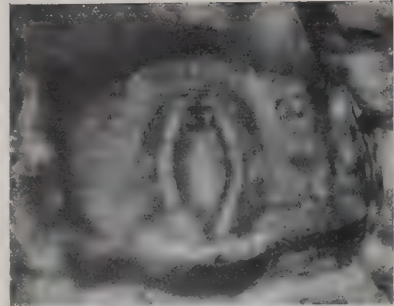
Aus diesen Versuchsergebnissen dürfte ohne weiters hervorgehen, dass die durch Wasser-Verlust eng zusammengeschrumpften Innen-Nebenzellen der weit geöffneten Spalte bei Wasserzufuhr das Wasser rasch aufnehmen und die maximal gespannten Schliesszellen mit zunehmendem Turgordruck seitlich positiv drücken, wodurch der plötzliche Verschluss der Spalte herbeigeführt wird.

## VI. Die Spaltöffnungsbewegung in der Natur

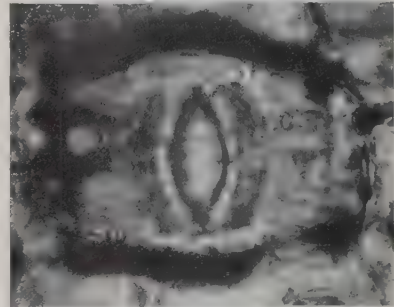
Die Maximalweite der künstlich geöffneten Spalte beträgt nur

Fig. 7. Die durch Aufstechen mit der Mikromanipulator-Nadel und durch Begiessen mit Wasser verursachte Weitenänderung der Spalte und der Zellen. Die Spaltöffnung ist dieselbe, die in Tab. 10 erläutert wird. (Vgl. Tab. 10).

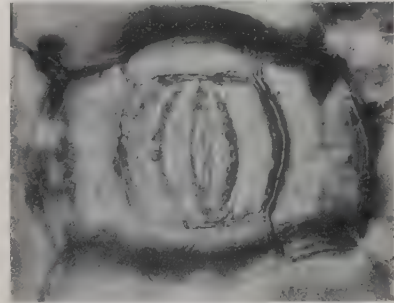
- a. 5 Min. nach Abziehen. (Ohne Wasserversorgung).
- b. 8 Min. nach Abziehen. (6 Min. nach Abziehen wurde die Innen-Nebenzelle (links) aufgestochen: das ausgeflossene Plasma klebte an der Aussen-Nebenzelle (links) tropfenweise).
- c. 18 Min. nach Abziehen. (10 Min. nach Abziehen mit Wasser versorgt).
- d. 27 Min. nach Abziehen. (25 Min. nach Abziehen wurde die andere Innen-Nebenzelle (rechts) aufgestochen).



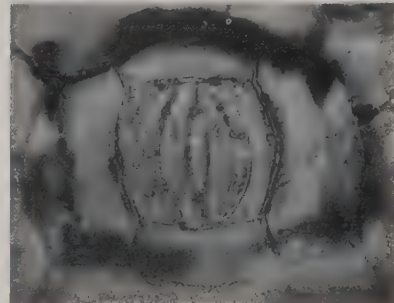
a



b



c



d

um  $5-7 \mu$ , aber in der Natur sind selbst Weiten über  $15 \mu$  keine Seltenheit. Um der Ursache dieses bedeutenden Unterschiedes nachzugehen, habe ich neben der Mitwirkung der Nebenzellen auch einmal über andere Teilgebiete des Öffnungsmechanismus, z.B. Ansteigen des osmotischen Wertes und Plasmazustands-Veränderung der Schliesszellen, eine Überlegung gemacht.

Dass der osmotische Wert der Schliesszellen durch Belichtung und Öffnung der Spalten stark zunimmt, wurde schon von ILJIN (1915), WIGGANS (1922), STEINBERGER (1922) u. A. einwandfrei nachgewiesen. Dass ferner das Schwinden der Stärkekörner in der Schliesszelle von dem Öffnen der Spalte begleitet ist, wurde durch ILJIN (1915), STRUGGER u. WEBER (1922), STEINBERGER (1922) u. A. an verschiedenen Pflanzenarten beobachtet. Eine beiden Erscheinungen gerecht werdende Erklärung haben ILJIN (1915), STEINBERGER (1922), SCARTH (1927), WEBER (1927b) mit dem Hinweis auf die osmotische Erhöhung durch Anatonose der Stärkekörner in den Schliesszellen gegeben. Diesbezüglich konnte ich auch am *Commelina*-Blatt, mit Ausnahme des völligen Schwundes der Stärkekörner, fast die gleichen Versuchsergebnisse gewinnen.

Der osmotische Wert der Schliesszellen der Versuchspflanze war 0,25 mol an den Stomata des „Feucht-Dunkel“-Blattes, aber er stieg an den weit geöffneten Stomata des Blattes, das unter einer mit Wasserdampf gesättigten Glasglocke einige Stunden lang belichtet wurde, bis zu 0,35–0,5 mol an. Dabei nahmen die Stärkekörner in den Schliesszellen an Durchmesser ein wenig ab, wenn auch ein vollkommenes Verschwinden derselben nicht beobachtet wurde. Der osmotische Wert der anderen Zellen entspricht sowohl in dem dunkel-geschlossenen Zustand, als auch in dem licht-geöffneten, beinahe 0,15 mol. Glykoselösung (vgl. Tab. 11).

TABELLE 11. Versuch S.3. Das Spalten-Öffnen, die Steigerung des osmotischen Wertes und Verkleinerung der Stärkekörner nach Belichtung von 3 Stunden. (Das Mittel der 10 Spaltöffnungen)

	10,00 Uhr (feucht-dunkel)					13,00 Uhr (3 Stunden belichtet)				
	Spalte	Schl.	Inn.-N.	Auss.-N.	Epid.	Spalte	Schl.	Inn.-N.	Auss.-N.	Epid.
Weite	0,0 $\mu$	14,2 $\mu$	14,4 $\mu$	29,3 $\mu$	—	11,0 $\mu$	18,2 $\mu$	3,3 $\mu$	28,6 $\mu$	—
Osm. Wert (M Glykose)	—	0,25	0,125	0,125	0,125	—	0,50	0,15	0,15	0,125
Stärke (Durchm. Zahl)	—	4,68 $\mu$ 12,20	—	—	—	—	3,86 $\mu$ 12,25	—	—	—

Nach den eben angeführten Daten können wir die Menge der in einer Schliesszelle hydrolysierten Stärke mit einiger Sicherheit schätzen.

Dieselbe ist etwa  $1,8 \cdot 10^{-10} \text{g}$ , wenn man das Stärkekorn als eine Kugel ansieht, deren spezifisches Gewicht  $1,25^{(1)}$  und Stärkegehalt  $50\%^{(2)}$  ist. Andererseits, wenn die Erhöhung des osmotischen Wertes der Schliesszellen als Glykose-Zunahme hypothetisch berechnet wird, so muss die Glykose in einer Schliesszelle um etwa  $2,0 \cdot 10^{-10} \text{g}$  zunehmen, um den osmotischen Wert um  $0,25 \text{ mol}$  zu steigern. Dabei schätze ich die Form der Schliesszelle als ein Prisma, dessen Länge, Höhe bzw. Base  $60\mu$ ,  $10\mu$  und  $15\mu$  ist. Wenn die Stärke ganz vollkommen zu Monosaccharid, d.h. Glykose hydrolysiert wird, so muss die berechnete Menge der hydrolysierten Stärke der gemessenen Erhöhung des osmotischen Wertes entsprechen. Aber dieser Fall dürfte in Wirklichkeit gar nicht eintreten, weil die Stärke nicht nur zu Glykose allein, sondern auch zu Maltose und Dextrinen hydrolysiert wird, die zwei letzteren sind freilich osmotisch unwirksamer als die erstere. Infolgedessen tritt keine Übereinstimmung der berechneten Quantitäten mit den aus der Beobachtung sich ergebenden ein. Den Fehlbetrag könnten aber die von Chloroplasten in den Schliesszellen assimilierten Kohlehydrate bis zu einem gewissen Grade ersetzen, weil die Ausbeute der Assimilation für eine Schliesszelle nach meiner Berechnung mit den LUNDEGÄRDHschen Daten (1930)  $1,0 \cdot 10^{-10} \text{g}$  oder noch mehr für dieselbe Zeitspanne (als Glykose) betragen kann.

Eine durch Belichtung verursachte oder von Öffnen der Spalte begleitete Änderung des Plasmazustandes der Schliesszelle hat WEBER schon mehrmals (1925, 1927b, c, 1929, 1930, 1932) auf Grund nach Plasmolyse-Zeit und -Form, sowie der Form und Sichtbarkeit des Zellkerns dargelegt. Die Ergebnisse meiner Untersuchungen in Bezug auf diese Anhaltspunkte stimmen fast völlig mit denen von WEBER überein. Die Plasmolyse-Zeit der Schliesszelle der im Feucht-Dunkel geschlossenen Stomata von *Commelina* beträgt meistens eine halbe oder eine Minute, aber die der im Feucht-Licht geöffneten Stomata wird nach zwei Minuten oder noch später erreicht. Das Protoplasma der Schliesszellen der ersteren Stomata haftet nach Plasmolyse, wie in Fig. 3 ersehen, glatt an der Bauchseite der Zelle. Das der letzteren dagegen zeigt, wie aus Fig. 8 ersichtlich ist, eine typische Krampfplasmolyse—das Plasma bleibt noch lange nach der Plasmolyse an einigen Stellen der Rückwand der Schliesszelle band- oder fadenförmig haften. Der Zellkern der ersteren ist mehr oder weniger undeutlich, der der letzteren kann aber deutlich erkannt werden.

Es ist von vornherein klar, dass die Schliesszellen der geöffneten Stomata des belichteten Blattes von *Commelina* einen Plasmazustand

(1) (2) Nach Rika-Nenpyô (Naturwissenschaftler-Kalender), 1934, Tokyo, ist das spezifische Gewicht der Stärke  $1,53$ , aber da die frischen Stärkekörner gewöhnlich zur Hälfte mit Wasser zusammengesetzt sind (nach NÄGELI: Die Stärkekörner, 1858), so setze ich hier das spezifische Gewicht der Stärkekörner auf  $1,25$  an.



haben, der von jenem der geschlossenen Stomata des „Feucht-Dunkel“-Blattes weit verschieden ist.



Fig. 8. Krampfplasmolyse der Schliesszellen der weit geöffneten Spaltöffnung. (Vgl. Fig. 3 unten).

Auf Grund einer zusammenfassenden Wertung der bis jetzt erwähnten Versuchsergebnisse möchte ich versuchen, eine Theorie der Spaltöffnungsbewegung in der Natur aufzustellen.

Wenn der Standort der Pflanzen von feucht zu trocken und von dunkel zu licht sich verändert, so verlieren zuerst die Innen-Nebenzellen der geschlossenen Stomata durch kutikuläre Transpiration sowohl ihre inneres Wasser, als auch ihren Turgordruck. Die Schliesszellen, die zuvor von den Innen-Nebenzellen seitlich stark gedrückt worden sind, nehmen an Weite zu, und krümmen sich nach aussen, oder nach der Rückseite, gemäss dem Schwinden des Seitendruckes. Dann tritt das Öffnen der Spalten ein (STÄLFELT: passive Öffnung). Andererseits, wenn die Stärke der Schliesszellen hydrolysiert, und Kohlenstoffverbindungen in den Schliesszellen photosynthetisch aufgebaut werden, steigt der osmotische Wert derselben Zellen mit Belichtung allmählich. Auch der Plasmazustand der Schliesszellen verändert sich dabei. Folglich wird das Wasser-Gleichgewicht zwischen ihnen und den Nebenzellen gestört. Die osmotisch wachsenden Schliesszellen können eine Menge Wasser von den Innen-Nebenzellen einsaugen. Deswegen vermindern die Innen-Nebenzellen den Turgordruck<sup>(1)</sup> und die Weite noch mehr. Die schwach geöffneten Spalten öffnen sich weiter und weiter (STÄLFELT: photoaktive Öffnung). Schliesslich entsteht aber das Gleichgewicht aufs neue, wenn der Zellsaft der Innen-Nebenzellen durch Wasserentzug sich ziemlich konzentriert, und die Schliesszellen mit Wasser völlig gesättigt werden, anders gesagt, wenn

(1) Um diese Annahme zu bestätigen, machte ich eine Mikromanipulator-Versuch. Wie es in folgender Tabelle klar ersichtlich ist, tritt nur eine ganz schwache Volumen-Änderung der Schliesszelle und Innen-Nebenzelle nach dem Aufstechen der letzteren Zelle an den weit geöffneten Stomata ein.

Versuch M.31. Ohne Wasser-Versorgung. 1 Mikrometer-Teilstrich = 3,18 $\mu$ . Vgl. Tab. 4

Aufgestochene Zellen	Auss-N.	Inn-N.	Schl.	Spalte	Schl.	Inn-N.	Auss-N.
	11,4	2,0	6,5	3,4	6,4	2,7	10,6
Innen-Nebenzelle (links)	11,6	(1,7)	6,6	3,4	6,4	2,7	10,6
„ „ (rechts)	11,6	(1,9)	6,5	3,3	6,5	(2,5)	10,7
Schliesszelle (rechts)	11,6	(2,3)	6,5	1,4	(5,9)	4,4	10,9
„ (links)	11,6	(3,8)	(6,5)	0,0	(6,0)	(4,4)	10,7



die zunehmende Saugkraft der Nebenzellen gleich der abnehmenden der Schliesszellen wird. Jetzt erreicht die Öffnungsweite der Spalten das Maximum. In diesem Zustand dürfte die Transpiration maximal oder ähnlich sein. Infolgedessen wird der Wasservorrat des Blattes mit der Zeit geringer. Der Turgordruck der Schliesszellen nimmt mit Wasserverlust wie der von anderen Zellen ab. Deshalb beginnen die maximal geöffneten Spalten am konstant licht-trockenen Standort sich zu schliessen (STÅLFELT: hydroaktive Schliessung).

Wenn der Standort eines Blattes mit maximal geöffneten Spalten zu feucht wird, so kommt ein anderer Spaltenverschluss (STÅLFELT: passive Schliessung) vor, weil die durch Wasser-Verlust an Saugkraft zunehmenden Innen-Nebenzellen das Wasser schneller und leichter, als die mit Wasser maximal gespannten Schliesszellen ohne Saugkraft, aufnehmen, und die ersteren mit ihrem dabei zunehmenden Turgordruck die letzteren von aussen seitlich so stark drücken können, dass die weit geöffneten Spalten passiv völlig sich schliessen müssen.

## VII. Zusammenfassung

1. Um die Mitwirkungen der Nebenzellen und Epidermiszellen auf die Spaltöffnungsbewegung direkt zu konstatieren, habe ich vorliegende Untersuchungen ausgeführt.

2. Als Versuchsmaterial gebrauchte ich meistens einen mit einer Pinzette abgezogenen Epidermisstreifen der Unterseite des Blattes von *Commelina communis*, das entsprechend dem Versuchszweck im feuchtdunklen oder feucht-lichten Zustand erhalten wurde, um die Spalten sich schliessen oder öffnen zu lassen. Die Stomata-Schliesszellen dieser Pflanze sind von drei Paaren Nebenzellen, nämlich vor und hinter den Schliesszellen liegenden Polar-Nebenzellen, und seitlich liegenden Innen- und Aussen-Nebenzellen, umgeben. Die Innen-Nebenzelle hat bedeutend mehr Höhe als Weite.

3. Wenn der Turgordruck der Innen-Nebenzelle durch Verletzung, Wasserentzug mit Zuckerlösung, oder durch Aufstechen mit Mikromanipulator-Nadel verschwunden ist, so wird die Herrschaft der Nebenzelle über die Schliesszelle beseitigt mit dem Erfolge, dass die Schliesszelle sich mit Weitenzunahme nach ihrer Rückseite vergrössert, und so auch das Öffnen der dunkel-geschlossenen Spalte vorkommt. Aber, verlieren auch die Schliesszellen ihren Turgordruck, so kann freilich keine Öffnung der Spalte mehr vorhanden sein. Sowohl die Polar- und Aussen-Nebenzellen, als auch die normalen Epidermiszellen, üben keinen oder beinahe keinen Einfluss auf die Schliesszellen und die Spalte aus.

4. Durch Trockenwerden der das Blatt umgebenden Luft können auch die dunkel-geschlossenen Spalten des unverletzten Blattes mit der

Erweiterung der Schliesszellen und der antagonischen Verengerung der Innen-Nebenzellen sich öffnen.

5. Beim Eintauchen des Epidermisstreifens des belichteten Blattes in Wasser nehmen die durch Wasserverlust ganz zusammengepressten Innen-Nebenzellen der weit geöffneten Stomata infolge raschem Wassereinsaugen an Turgordruck und Weite zu. Durch den so entstandenen starken Seitendruck nimmt die Weite der maximal gespannten Schliesszellen ab, und die Spalten beginnen sogleich nach dem Eintauchen passiv sich zu schliessen.

6. In der Natur spielen, neben der Mitwirkung der Innen-Nebenzellen, die eigentümlichen Wirkungen der Schliesszellen, die sich teils in der Änderung des osmotischen Wertes und teils in der des Plasmazustandes ausdrücken, eine wichtige Rolle bei der Spaltöffnungsbewegung.

Besonderen Dank schulde ich Herrn Prof. Dr. H. NAKANO für seine wertvollen Ratschläge und freundliche Leitung bei der Arbeit. Auch Herrn Privatdozenten, Dr. B. WADA, sage ich meinen besten Dank dafür, dass er mir seinen Mikromanipulator zur Verfügung gestellt hat. Endlich bin ich noch „Tôsyôgû 300 nen-Sai Kinenkai“ für die Unterstützung meiner Arbeiten zum Dank verpflichtet.

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## Abstracts Nos. 489-630

(Referring to the principal papers on Botany and allied subjects which have appeared in Japan mostly during January-June 1938)

**489. Entwicklung der Fortpflanzungsorgane und Keimungsgeschichte von *Desmarestia viridis* (MULL.) LAMOUR.** Kôgorô ABE. (Sc. Rpts., Tôhoku Imp. Univ. IV. Ser. 12, 1938, 475-482, 1 Taf. und 5 Textfig.).

Im Jahre 1932 hat SCHREIBER eine Abhandlung über *Desmarestia aculeata* (L.) LAMOUR. veröffentlicht, wonach er dabei einen regelmässigen Generationswechsel eines zwerghaften Gametophyts und stattlichen Sporophyts nachgewiesen hat. Die im vorliegenden Aufsatz geschilderten Studien Verfs. über *Desmarestia viridis* zeigen daraus gewisse Unterschiede.

Die kleinen Höcker, welche stellenweise an dem Thallus sich entwickeln, enthalten den aus unilokulären Sporangien gebildeten Sorus, deren Entstehung den Teilungen und dem nachfolgenden Wachstum der Rindenzellen zu verdanken ist. Jedes Sporangium enthält im Anfang einen einzigen Zellkern, welcher bald sich wiederholt mitotisch teilt, wobei man  $\pm 22$  Chromosomen (reduziert) und ein zentrosomartiges Körperchen erkennen kann. Darauf kommen aus jedem Sporangium eine Anzahl Schwärmsporen hervor, von welchen jede mit zwei Geisseln, einem Chromatophor und einem roten Augenfleck versehen ist. Diese Schwärmer keimen ungeschlechtlich und bilden je einen Keimling aus, worüber man die Entwicklung einer sphärischen Eizelle nachgewiesen hat, obgleich der Verf. keine Antheridien bestimmt beobachten konnte. Nach den Ergebnissen des Verfs. Kulturexperimente hat er nach einigen Monaten die Entstehung daraus der vom Substrat ungefähr aufrecht stehenden monosiphonen spießesförmigen Fäden nachweisen können, welche nach der Ansicht Verfs. die Anfänge der Sporophyten darstellen dürften.

Die Schwärmer kopulieren sich manchmal je zwei zueinander, um eine Zygote auszubilden. Die letztere keimt wie gewöhnlich, wenn das weitere Verhalten derselben nicht verfolgt werden konnte.

**490. On the susceptibility of back-crossed offspring of pentaploid wheat hybrids to *Puccinia triticina*.** (Japanese). Takuji ABE and Seiji MATSUMURA. (Proc. Soc. Crop Sc. Japan 10, 1938, 71-84).

It is well known that the emmer wheat is more resistant against the invasion of various pathogenic fungi than the dinkel (common) wheat. The authors have studied in this respect the pentaploid wheats, through either the observation of natural infection or the performance of artificial inoculation. Among the emmer wheat *Triticum durum* var. *Reichenbachii* and *T. polonicum* var. *vestita* and among common wheat *T. vulgare* var. *erythrospermum* and *T. Spelta* var. *Duhamelianum* were taken for the objects of experimentation, and the resistance against *Puccinia triticina* was examined.

In 1936 the natural infection in the field was observed. According to the results of such observations it was seen that *T. polonicum* and *durum* ( $2n = 28$ ) suffer very slightly, if any, from the disease, whilst *T. Spelta* and *vulgare* ( $2n = 42$ ) suffer heavily from it. Further, the  $F_1$  hybrids between *T. polonicum* and *Spelta* on one hand and those between *T. durum* and *T. vulgare* on the other (either of both reciprocals) were found to suffer pretty heavily from the disease, so that in this respect they are nearer to *T. Spelta* or *vulgare* (dinkel) rather than to two other parents (emmer).

Similar results were got in 1937 also in the case of artificial inoculation experiments of *Puccinia triticens*.

The artificial inoculation by summer spores of young seedlings of back-cross plants, viz. *T. polonicum*  $\times$   $F_1$  and *T. durum*  $\times$   $F_1$ , and their respective reciprocals ( $2n = 28 - 35$ ) were executed. Through these experiments it was confirmed that the more numerous the chromosome number of each plant, the higher was its susceptibility to the disease, the correlation coefficient between them being  $r = +0.4021 \pm 0.0504$ . It will be remarked that the increase of the chromosome number in all these cases is that of the chromosomes contained in the D-genom derived from common wheat. On the contrary, in the case of *T. vulgare*  $\times$   $F_1$  and *T. Spelta*  $\times$   $F_1$  and their respective reciprocals, which are also susceptible to the disease, the susceptibility does not become particularly high parallel to the increase of the chromosome number ( $r = +0.0651 \pm 0.0467$ ).

All above experiments have shown that the susceptibility to the disease under question is fundamentally correlated with the D-genom, though it may be scarcely stated, that it is exclusively so. (Cf. different papers of MATSUMURA on pentaploid wheat which have several times appeared in this JOURNAL).

**491. On the systematic anatomy of the leaves of some Japanese Carices. XIII-XIV.** (Japanese with English résumé). Shigeo AKIYAMA. (Bot. Mag. Tôkyô **52**, 1938, 142-146, 201-205, altogether 4 text-figs. groups).

On account of the purely descriptive character of this paper it is quite impossible to review here the detailed description of what the author announces. The following are some summaries of the results. In respect to the anatomical structure of the leaves of four *Carex* species, viz. *C. otariensis*, *forficula*, *sadoensis* and *heterolepis*, all are in accord in several points. Especially the existence of spine cells which are accompanied by thick-walled cells at their bases and which occur either in the upper or lower epidermis, is characteristic in all four species. Further, in all of them the spherical protuberance occurs in the lower epidermis, and the subsidiary cells of the stomata are projecting out to some extent, etc.

**492. Mikrochemischer Nachweis der Flechtenstoffe. V-VII. Mitteilung. Spezieller Teil III. Nachweis der Flechtenstoffe, die durch Chlorkalk nicht gerötet werden (Fortsetzung).-IV. Nachweis der Flechtenstoffe, die durch KOH+Ca(OCl) gerötet werden.** Yasuhiko ASAHINA oder Y. ASAHINA und M. MITUNO. (Jour. Japan. Bot. **14**, 1938, 39-44, 244-260, 318-323, im ganzen 30 Textabb.).

Unter den Flechtenstoffen, die durch Chlorkalk nicht gerötet werden, sind die Nachweismethoden von Sphaerophorin (aus einigen *Sphaerophorus*-arten), Perlatorinsäure und Imbricatsäure (aus *Parmelia cetrarioides* var. *typica*), Mikrophyllinsäure (aus *Cetraria japonica*), Squamatsäure (aus *Cladonia squamosa*), Sekikasäure und Ramalinolsäure (aus einigen *Ramalina*-arten), Boninsäure (aus *Ramalina boninensis*), Homosekikasäure (aus *Cladonia pityrea*), beschrieben. Unter den Flechtenstoffen, die durch KOH + Ca(OCl) gerötet werden, sind die Nachweismethoden von Collatolsäure (= Lecanorolsäure) (aus *Cetraria collata*, *Lecanora atra*, *Nephromopsis ciliaris*), Aletronsäure (aus einigen *Alectoria*-arten), Lobarsäure (aus *Stereocaulon paschale*), Physodsäure (aus *Parmelia physodes*) angedeutet. Es ist natürlich kaum möglich, jede Nachweismethode der oben genannten Stoffe hier zu schildern, wofür auf das Original verwiesen sei.



**493. Lichenologische Notizen (X). 26. Ueber die Identität der Nemoxynsäure mit der Homosekikasäure.—27. *Ramalina boninensis*.** Yasuhiko ASAHINA. (Jour. Japan. Bot. 14, 1938, 251-255, 5 Textfig.).

Früher hatte ZOPF aus *Cladonia nemoxyna* einen Flechtenstoff extrahiert, welchen er Nemoxynsäure genannt hatte. Wegen der Uebereinstimmung des Schmelzpunktes dieses Stoffes mit Homosekikasäure, welche der Verf. aus *Cladonia pityrea* bekommen hatte, ist er zur Vermutung angekommen, dass diese beiden Stoffe zueinander identisch sein mögen. Diese Vermutung wurde tatsächlich bestätigt, und zwar durch die Untersuchungen Verfs. an neun als *Cladonia nemoxyna* sicherbestimmten Exemplaren, wobei in allen Fällen ausnahmslos das Vorhandensein der Homosekikasäure festgestellt worden ist. *Cladonia cornuto-radiata* stimmt äusserlich mit *Cl. nemoxyna* ganz überein, aber die erstere Art enthält die Fumarprotocetrarsäure statt der Homosekikasäure. Diese beide Flechtenarten sind daher die schöne Beispiele von morphologisch gleichen und doch chemisch verschiedenen Formen.

*Ramalina boninensis* wird beschrieben. Äusserlich ähnelt diese Art ganz *R. fraxinea*, aber unterscheidet sich daraus durch den Gehalt an Boninsäure.

**494. Myxomyceten aus Hokkaido.** (Japanisch m. deutsch. Zfg.). Yoshikadzu EMOTO. (Bot. Mag. Tôkyô 52, 1938, 160-164, 1 Taf.).

Bisher sind aus Hokkaidô nur 26 Arten und Varietäten der Myxomyceten bekannt gewesen. Der Verf. hat im Sommer 1937 die Gelegenheit, dort die Myxomyceten zu sammeln, und er konnte dabei im ganzen 11 Familien, 27 Gattungen, 59 Arten und 14 Varietäten erkennen. Alle von ihm gesammelten Arten und Varietäten sind in dem vorliegenden Aufsatz hervorgehoben. Unter diesen sind die Plasmodien von *Lindbladia effusa* var. *cribranoides* merkwürdig, welche an faulenden Hölzern von *Abies Mayriana* wachsend aufgefunden wurden. Weiter ist *Physarum Newtoni* als merkwürdig genannt.

**495. Ueber die Entstehungsweise des Sporophylls bei *Equisetum hyemale* L. var. *japonicum* MILDE mit besonderer Rücksicht auf die Stellungsverhältnisse.** (Mit japan. Zfg.). Tetsuo FUJITA. (Bot. Mag. Tôkyô 52, 1938, 16-23, 1 Taf. u. 9 Textfig.).

Bei *Equisetum hyemale* gibt es keine Differenzierung zu den fertilen und sterilen Sprossen, und der ährenförmige, aus den Sporophyllen bestehende Strobilus entwickelt sich am Gipfel des vegetativen Sprosses. Beide Teile sind durch den Annulus begrenzt, welcher nichts anderes ist als einen unvollkommenen Blattwirtel.

Bei der Entwicklung des Strobilus entsteht am Vegetationspunkt zuerst ein gewölbter Ringwall, welcher aus 5-6 Oberflächenzellen zusammengesetzt ist. Die Anlage der wirtelständigen Sporophylle entsteht auf diesem Ringwall, wobei die Anlagen der aufeinanderfolgenden Wirtel gewöhnlich regelmässig alternieren, wenn diese Regelmässigkeit oft gestört werden kann. Die Zahl der Wirtel in einem Strobilus beträgt 5-8, gewöhnlich 7. Nachdem die obengenannte Anlagebildung beendet ist, wird das Dickenwachstum des Strobilus immer stärker. Wenn die Sporophylle der mittleren Knoten grösser als die der übrigen werden, entstehen die Sporangien auf den Sporophyllrücken, und ihre Zahl wird durch die Grösse des Sporophylls bestimmt. Wenn das Sprossende meistens ganz steril bleibt, kann es selten einige Sporangien an seiner unteren Seite tragen.

**496. *Studia orchidacearum japonicarum* X. *Orchidaceae formosanae novae vel minus cognitae*.** (With Japan. résumé). Noriaki FUKUYAMA. (Bot. Mag. Tôkyô 52, 1938, 242-247, 272-273).

*Cephalanthera alpicola*, *Tipularia odorata*, *Liparis amabilis*, *Sarcochilus laurissilvaticus*, and *Taeniophyllum crassipes* are described as new species.

**497. Relationship of genom to secondary pairing in *Brassica*. (A preliminary note).** Tutomu HAGA. (Japan. Jour. Gen. **13**, 1938, 277-284).

Types of the maximum secondary pairing of the meiotic chromosomes in *Brassica nigra* ( $n = 8$ ), *B. oleracea* ( $n = 9$ ) and *B. juncea* ( $n = 18$ ) were found to be as follows:

n	Maximum type	Genom (n)	Chromosome constitution (n)
8 <sub>II</sub>	2 (2 <sub>II</sub> ) + 4 (1 <sub>II</sub> )	b	ABCD (EE) (FF)
9 <sub>II</sub>	3 (2 <sub>II</sub> ) + 3 (1 <sub>II</sub> )	c	(AA) (BB) (CC) DEF
10 <sub>II</sub>	—————	a	(AA) (BB) (CC) (DD) EF
18 <sub>II</sub>	5 (3 <sub>II</sub> ) + 3 (1 <sub>II</sub> ), potentially 6 (3 <sub>II</sub> )	a + b	(AAA) (BBB) (CCC) (DDD) (EEE) (FFF)

On the basis of the above findings the chromosome constitutions of the genomes were suggested as shown above, in which genom a is taken as the standard, the primary basic number being 6. These formulations possibly are correlated with the phenomena of aneuploidy, of secondary pairing and the presence of multiple factors in this genus in a single consistent system. Author.

**498. Genetic studies of speckled flowers in *Pharbitis Nil*. (With English résumé).** Tokio HAGIWARA. (Bot. Mag. Tôkyô **52**, 1938, 99-112).

The speckled flowers of the Japanese morning-glory, *Pharbitis Nil*, are characterized by the fact, that the corolla is provided with fine spots of anthocyanin. For the production of such flowers which are recessive to normal self-coloured ones three genes  $s_{p1}$ ,  $s_{p2}$  and  $s_{p3}$  are responsible, inasmuch as either  $s_{p1}$  or  $s_{p1} + s_{p2}$  will give rise to them (for instance,  $s_{p1} + s_{p2} + s_{p3}$  speckled,  $s_{p1} + s_{p2} + s_{p3}$  normal).

The ground colour of speckled flowers is either yellow or white, and for these characters three genes  $c$ ,  $c_y$  and  $c_{y-s}$  were detected. Further two other genes, viz.  $tw_2$  for white flower tube and  $r$  for white flower were observed.

On the basis of linkage data between several genes above indicated the author has determined their respective loci on the chromosomes.

**499. Four genes for variegated leaves supposed by linkage in *Pharbitis Nil*. (With English résumé).** Tokio HAGIWARA. (Bot. Mag. Tôkyô **52**, 1938, 146-160).

Concerning the variegation in *Pharbitis Nil* the author could identify four genes, one of which is dominant ( $V_4$ ) and three others recessive ( $v_1$ ,  $v_2$  and  $v_3$ ). Several other genes were detected, and on the basis of the author's experimental results he could establish four linkage groups. For several genes contained in each of them the recombination value is given.

**500. Anomalous secondary growth in the axis of *Bauhinia Championi* BENTH.** Tsugio HANDA. (Japan. Jour. Bot. **9**, 1938, 303-311, 1 pl. and 2 text-figs.).

**501. Observationes ad plantas Asiae Orientalis (XV).** (With Japan. résumé). Hiroshi HARA. (Jour. Japan. Bot. **14**, 1938, 49-56, 1 text-fig.).

The following new species are described: *Astilbe kiusiana* and *Sparganium Kawakamii*.

**502. Notes on the Japanese *Sparganium*.** (Chiefly in Japanese). Hiroshi HARA. (Jour. Japan. Bot. **14**, 1938, 132-136, 1 text-fig.).

7 species of the genus *Sparganium* are enumerated. An analytical key for the identification of them and some other species is given.

**503. Preliminary report on the flora of Southern Hidaka, Hokkaido (Yezo). XXIV-XXIX.** (With Japan. résumé). Hiroshi HARA. (Bot. Mag. Tôkyô **52**, 1938, 1-8, 52, 65-73, 113-114, 121-123, 165, 181-188, 216, 227-234, 270, 283-290, 329).

**504. Contributiones ad dendrologiam nipponiae australis (IV).** (With Japan. résumé). Sumihiko HATUSIMA. (Jour. Japan. Bot. **14**, 1938, 236-244, 1 text-fig.).

*Evodia Awadan* sp. nov. and some other species are described.

**505. Miscellaneous notes on the East-Asiatic Uredinales with special reference to the Japanese species. (III).** Naohide HIRATSUKA. (Jour. Japan. Bot. **14**, 1938, 33-38).

Several species belonging to *Pucciniastrum*, *Thekospora*, *Melampsora*, *Chrysomyxa*, *Crossopora*, *Puccinosira*, *Pileolaria*, *Maraschia*, *Uromyces*, *Puccinia*, *Aecidium*, and *Uredo* are enumerated, among which *Aecidium nitakense* on *Berberis morrisoensis* from Formosa is new and described.

**506. Gestalt vom Zellkerne im Innern des Reispollens und sein Verhalten bei der Pollenkeimung.** (Japanisch). Isao HIRAYOSHI. (Proc. Soc. Crop Sc. Japan **10**, 1938, 68-70, 1 Textfig.).

Indem das Verhalten des im Pollen des Reises befindlichen Zellkernes noch nicht genau untersucht worden ist, hat der Verf. in dieser Hinsicht einige neue Beobachtungen ausgeführt. Dabei ist es zu bemerken, dass der Nachweis von durch Färbemitteln behandelten Zellkernen im Pollen oft wegen der darin dicht gelagerten Stärkekörner kaum möglich ist. Solche Schwierigkeit der Beobachtung wurde durch den Gebrauch einer von Herrn GONDÔ mitgeteilten einfachen Methode beseitigt, welche darin besteht, dass zuerst man einige Tropfen gewöhnlicher Essigkarminlösung auf den Objektträger bringt, die zu untersuchenden Pollenkörner sofort darin setzt, das ganze mit einem Deckglas bedeckt und erst nach 10 Minuten zu beobachten anfängt. (Oder man setzt die Pollenkörner in die auf dem Objektträger befindlichen Essigkarminlösung ein, wartet 10 Minuten, bedeckt das ganze mit einem Deckglas, in welchem Falle man sofort die Beobachtung vornehmen kann). Man wird sehen, dass dank dieser Untersuchungsmethode alle Stärkekörner einseitig nahe einer Keimpore des Pollens angesammelt sind, sodass die Zellkerne sich im durchsichtigen Zytoplasma eingebettet befinden.

Nach den Beobachtungen des Verfs. gehen alle drei Kerne, d.h. zwei keil- oder spindelförmige Spermakerne und ein ellipsoidischer vegetativer Zellkern bald nach dem Pollenschlauchinnern hinein, gewöhnlich der erste und der zweite Spermakern und dann erst der vegetative Kern. Es ist merkwürdig, dass der Pollendurchmesser bei *Oryza minuta* (tetraploid) kleiner ist als bei *O. sativa* (diploid) (z.B.  $\pm 21$  bzw.  $27\mu$ ). Das gleichartige Grössen-Verhältnis weist man auch bei den vegetativen Organen beider Arten nach (Blätter, Halme usw.).

**507. Some cyanophycean algae from Hokkaido (IV)-(V).** (Japanese). Hiroyuki HIROSE. (Jour. Japan. Bot. **14**, 1938, 89-100, 164-170, altogether 25 text-figs.).

The following species are described with illustrations: *Microchaete* (1 sp.), *Tolypothrix* (2 sp. and 1 var.), *Scytonema* (2 sp.), *Hydrocoryne* (1 sp.), *Cylindrospermum* (2 sp.), *Nostoc* (3 sp.), *Nodularia* (1 sp.), *Anabaena* (2 sp.), *Oscillatoria* (4 sp.), *Phormidium* (3 sp.), *Limbya* (3 sp., of which one *L. akkeshiensis* is described as a new species), *Schizothrix* (1 sp.), *Microcoleus* (1 sp.).

**508. Nuntia ad floram japoniae, XXXV.** (With Japan. résumé). Masazi HONDA. (Bot. Mag. Tôkyô **52**, 1938, 139-141, 167-168).

The following plants are contained in this paper: *Frangula crenata* MIQUEL var. *macrophylla* HONDA var. nov., *Rosa Wichuriana* CRÉPIN var. *ampullicarpa* (KOIDZ.) HONDA comb. nov., *Scirpus lacustris* L. var. *typica* HONDA f. *pictus* HONDA var. et forma nov., *Dianthus superbus* L. var. *albiflora* HONDA forma nov., *Reynoutria japonica* HOUTTUYN. var. *hastata* (NAKAI) HONDA comb. nov., *Viola yezoensis* MAX. var. *dissecta* HONDA var. nov., *Platycodon glaucum* NAKAI var. *typica* HONDA forma *album* (hort.) HONDA comb. nov.

**509. A new species of *Dioscorea* from Izu-Islands.** (With Japan. résumé). Masazi HONDA and Satio JÔTANI. (Jour. Japan. Bot. **14**, 1938, 234-235).

*Dioscorea sititona* HONDA et JÔTANI sp. nov. is described.

**510. Contributions to the knowledge of the systematics of *Morus* in Japan IX.** (With Japanese résumé). Teikichi HOTTA. (Acta Phytotax. et Geobot. **7**, 1938, 20-28).

First of all, a key for the determination of the species, varieties and forms of *Morus* found in Honsyû (Nippon of the European authors) is given. Of Sec. I *Dolichostylae* KOIDZ. *Morus cordifolia* is a new species; furthermore, *M. bombycis* KOIDZ. and its several varieties as well as *M. Kagayamai* KOIDZ. with a new variety are noticed. Of Sec. II *Macromorus* KOIDZ. *H. tiliaefolia* MAKINO with 1 new variety, and *M. boninensis* KOIDZ. with 1 new var. are noticed.

**511. Contributions to the knowledge of the systematics of *Morus* in Japan IX, X, XI, XII.** (With Japan. résumé). Teikichi HOTTA. (Bot. Mag. Tôkyô **52**, 1938, 73-81, 5 text-figs., 114, 196-200, 248-255, 2 text-figs., 273).

A key for the determination of the species, subspecies, varieties and forms of *Morus* in Sikoku and Kyûsyû is given. *Morus bombycis* KOIDZ. with 8 varieties (of which some are new) and 1 forma, *M. australis* POIRET and *M. tiliaefolia* MAKINO are enumerated. In all 3 species and 8 varieties and 1 form are now known to occur in S'koku and Kyûsyû.

A key for the determination of the species, varieties and forms of *Morus* in cultivation is given. *M. Mizuho* HOTTA with 1 new form, *M. bombycis* KOIDZ. with 5 new forms, *M. alba* L. with 2 new var. and 6 new forms, *M. latifolia* POIRET with 2 new var. and 2 new forms are enumerated.

A key for the determination of the species, varieties and forms of *M.* found in Korea is given. *M. mongolica* G. S. SCHNEIDER with 1 var., *M. bombycis* KOIDZ. with 6 var. and 1 form, *M. tiliaefolia* MAKINO, *M. alba* L. with 1 var. and *M. latifolia* POIRET are noticed.

**512. Third note on *Elaphomyces* and fungus-habiting *Cordyceps* in Japan.** Sanshi IMAI. (Proc. Imp. Acad. **14**, 1938, 18-20, 8 text-figs.).

Three fungi collected in Northern Honsyû are recorded. One of them is *Elaphomyces nikkoensis* sp. nov., allied to *E. echinatus*. Two others are *E. granulatus* FR. and *Cordyceps ophioglossoides* which is parasitic on the latter fungus.

**513. Studies on the Agaricaceae of Hokkaido I-II.** Sanshi IMAI. (Jour. Fac. Agric., Hokkaido Imp. Univ. **43**, 1938, 1-378, 7 pls.).

This paper consisting of two parts is a systematic enumeration of all Agaricaceae hitherto recognized in Hokkaidô. They were collected by the author himself as well as others, numbering in all 348 species incl. 7 forms, of which 40 species and 3 forms are new. 6 subfamilies, 21 tribes, and 51 genera are distinguished.



First of all, the key for the identification of subfamilies and tribes, and for each genus that for the identification of sections and species contained in it are given. The following genera are enumerated and each species belonging to them are described in detail (the figures within the brackets denote the number of species): *Amanita* (18), *Amanitopsis* (8), *Lepiota* (16, among which 3 are new, viz. *L. subamanitiformis*, *subglischra*, *ossaeiformispora*), *Armillaria* (7), *Cortinellus* (10), *Tricholoma* (15, among which *T. porpholophyllum* is new), *Clitocybe* (10, among which *C. fallax* is new), *Laccaria* (3, among which *L. murina* is new), *Pleurotus* (4), *Hygrophorus* (18, among which *H. subniveus* and *carnescens* are new), *Collybia* (8), *Mycena* (9), *Omphallia* (3), *Marasmius* (5), *Lentinus* (6), *Panus* (2), *Trogia* (1), *Schizophyllum* (1), *Volvaria* (4), *Pluteus* (8, among which *P. macrosporus* and *bulbosus* are new), *Entoloma* (8, among which *E. subnitidum* is new), *Clitopitus* (2), *Claudopus* (1), *Leptonia* (3, among which *L. umbrinella* is new), *Nolanea* (1), *Rozites* (1), *Pholiota* (19), *Cortinarius* (17), *Inocybe* (6), *Hebeloma* (7, among which *H. Tomoeae*, *fumicolum*, *helvolascens* and *humosum* are new), *Gymnopilus* (6), *Rhodotus* (1), *Crepidotus* (8, among which *C. viticolus*, *terrestris* and *longistriata* are new), *Paxillus* (2), *Phylloporus* (1), *Naucoria* (2), *Galerula* (2), *Pluteolus* (1), *Agaricus* (12, among which *A. jezoensis*, *comptulellus* and *semotellus* are new), *Stropharia* (11, among which *S. bulbosa* is new), *Hypholoma* (7), *Gomphidius* (3), *Psilocybe* (1), *Paraeolus* (4), *Psathyra* (2, among which *P. multissima* and *microspora* are new), *Psathyrella* (2), *Coprinus* (6), *Lactarius* (27), *Russula* (20, among which *R. senecis* is new), *Cantharellus* (6), *Neurophyllum* (1).

**514. The genes of the Japanese morning glory.** Yoshitaka IMAI. (Japan. Jour. Gen. **14**, 1938, 24-33).

The author has published in 1933 a list of 111 genes in the Japanese morning glory which were known in that time. Since then 44 new genes became known, making the total 155. In the list presented in the paper above cited all these genes are enumerated, each with a short diagnosis. The cited literature ends the paper, all issued from the Japanese investigators, incl. the author himself.

**515. Genetic literature of the Japanese morning glory.** Yoshitaka IMAI. (Japan. Jour. Gen. **14**, 1938, 91-96).

A list of the papers concerning the genetic studies on the Japanese morning glory, 141 in all. They are due to 19 geneticists, all of which are Japanese, except one single. Many of these papers are the repetitions of those contained in the literature referred to in No. 514.

**516. The genes for double flowers in the commercial varieties of the perpetual carnation.** (With Japan. résumé). Yoshitaka IMAI. (Japan. Jour. Gen. **14**, 1938, 63-68, 2 text-figs.).

The commercial varieties of *Dianthus Caryophyllus* (perpetual carnation) are always double. Through either the inter- or outer-mating the mixed offspring are got, viz. single, standard double (like the parent), and bullhead double, the flower of the last showing an astonishingly large number of duplicated petals, 100-350.

The three kinds of offspring just indicated are in the ratio 1:2:1, but in some forms, such as the strain Spectrum, the inter- or outer-mating gives rise to the standard and bullhead double in the ratio 3:1. The first kind of the segregation is explainable by assuming the presence of one single dominant gene for doubleness, while for the explanation of the second that of two kinds of dominant genes for doubleness should be assumed.



**517. Flaked and mosaic heads of *Gomphonema globosa*.** (With Japan. résumé). Yoshitaka IMAI and Yasuo INUMA. (Japan. Jour. Gen. **13**, 1938, 269-276).

The so-called flaked heads of *Gomphonema globosa* are characterized by the presence of red spots of very various extent on pink ground, of which the one extreme is what the authors call "almost pink", i.e. pink with extremely slight red spots. Mosaics are plants provided with both red and flaked heads. The genetical investigations have shown that flaked is mutable and changes occasionally to red or pink. Red, flaked and pink form a series of multiple alleles, of which the first and the third are perfectly constant, and the second variable. Thus, for instance, the culture of flakeds in 1935 has given rise to red, flaked, and almost pink. Of these offspring, red has bred true to its type, while the two others were found to produce several different forms.

**518. On various forms of *Pinus pumila* distinguished by the structure of leaves with special reference to their distribution.** (Japanese). Seizi ISHII. (Jour. Japan. Forest. Soc. **20**, 1938, 309-324, 9 text-figs.).

The Japanese creeping pine, *Pinus pumila*, is found growing in Japan in the Central High Mountain Range of Honsyû (Japan Proper), measuring  $\pm 3000$  m. above sea-level as well as in Hokkaidô and Saghalien, where it grows even in sea coast. The author announces in this paper the relationship existing between the position of resin canals in leaves and the geographical distribution of this pine species. If we make a cross-section of a leaf it will be most easily seen that the resin canals are found either on their ventral or dorsal side and placed either in contact with the hypo- or epidermis, or in the mesophyll at some distance from the hypo- or epidermis. When they are present on ventral side they are always solitary, while on dorsal side one or two are present. Rarely the resin canals are entirely lacking. The most remarkable fact is that in the leaves of individuals from the Central High Mountain Range of Japan Proper the resin canals are always found exclusively on their dorsal side (one or two) (called Southern Type by the author), while in the leaves of individuals from Hokkaidô and Saghalien they are visible both on dorsal and ventral side (Northern Type). The type intermediate between the two just indicated is not lacking, thus, for instance, in leaves of plants from Mt. Esan of Southern Hokkaidô (620 m. high) both types are found mingled in one and the same tree.

Leaves of Southern and Northern type may be distinguished also externally: those of the latter type are slender and feeble in their appearance, while those of the former are shorter, thicker and stouter in their appearance than the other.

**519. New species of calcareous algae from several tertiary and later limestones from various localities of the Ryûkyû Islands.** Wataru ISHIJIMA. (Japan. Jour. Geol. & Geogr. **15**, 1938, 13-16, 1 pl.).

The following new species are described with illustrations: *Amphiroa howei*, *A. tenuis*, *A. longissima*, *Lithophyllum ryukyensis*, *Archaeolithothamnion hanzawai*.

**520. Studies on the nodule bacteria XI. Influence of some stimulating chemicals with special reference to the alkaloids upon the fixation of nitrogen.** Arao ITANO and Akira MATSUURA. (Ber. Ôhara Inst. landw. Forsch. **8**, 1938, 69-81, 7 tables).

Three strains of nodule bacteria on *Astragalus sinensis* were used for the experiment, and various chemicals were added to the nutrient medium (cf. this

JOURNAL 9, (113), No. 378). The purpose of the present experiment was to study, whether by the use of such stimulating chemicals the nitrogen fixation of bacteria may be intensified. The study was done by the chemical analysis of bacteria. The results were generally negative, except in the case of strychnine, when the increase of nitrogen in bacteria has been clearly indicated.

**521. Alteration of characters in some crop plants induced by X-ray irradiation.** (Japanese). FUYUWU KAGAWA. (Proc. Crop Sc. Soc. Japan 9, 1938, 465-470).

The germinating seeds of rye and rice-plant were subjected to a certain X-ray irradiation. The offspring of rye originating from such seeds were generally normal, but in a few cases the variegation consisting of longitudinal yellow and green stripes was seen in all or some stems of each individual. In another case of rye the offspring derived directly from X-rayed seeds were quite normal, but their seeds produced by natural pollination have given besides many normal a few dwarf plants.

In another case of rice-plant the offspring directly derived from X-rayed seeds were also quite normal, but in later generations a few albinos have appeared, which, as the author thinks, might have been produced probably by mutation induced by the X-ray irradiation.

**522. Eine Studie über die systematische Stellung der *Trichophyt*-Arten.** (Mit japan. Zfg.). TOYOAKI KAMBAYASHI. (Bot. Mag. Tôkyô 52, 1938, 291-297, 6 Textfig.).

Bei *Trichophyton* waren nur die Nebenfruktifikationsorgane, wie Konidien, Gemmen bekannt, und somit sind sie unter Fungi Imperfecti eingereiht worden bis zum Jahre 1926, wo MATRUCHOT und DASSONVILLE dabei die Askusbildung erkannten, um diese Pilzarten unter den Gymnoascaceen einzureihen. Die vorliegende Arbeit betreffend *Trichophyton lacticolor*. bezieht sich auf die Verfs. Untersuchungsergebnisse des gleichen Vorganges.

Die zwei Kopulationsäste erheben sich aus zwei benachbarten Zellen einer Hyphe; der eine derselben, Ascogonium, windet um das andere, das Antheridium, schraubig herum. Beide Geschlechtsorgane sind äusserlich sehr ähnlich, doch nicht ganz gleich, so kann man sagen, dass hier die Gametangienverschmelzung nach dem anisogamen Typus verläuft, wie bei *Plectascales*. Weiter hat der Verf. die parthenogenetische Entwicklung des Ascogoniums nachgewiesen. Nachdem beide Sexualorgane zur Verschmelzung angekommen sind, entstehen aus den Verschmelzungsprodukten die askogenen Hyphen, woraus eine Anzahl von 8-sporigen Asken bald entwickeln werden. Aus alledem kommt der Verf. zur Anschauung, dass dieser Pilz zu den Gymnoascaceen gehören muss.

**523. On the gametophytes of some Japanese species of *Laminaria* II.** TIYOITI KANDA. (Sc. Papers Inst. Algol. Res., Fac. Sc., Hokkaido Imp. Univ. 2, 1938, 87-111, 2 pls. and 24 text-fig.-groups).

The life history of *Laminaria Yendoana*, *cichorioides*, *yezoensis*, *Kjellmanniella crassifolia* and *Chorda Filum*, was traced by performing the culture. The alternation of generations—asexual zoospores→male and female gametophytes—as well as the development of young sporophytes were thus ascertained. These processes are similar in all forms above indicated. The zoospores and the male gametophytes lack the eye-spot, except in the last of the species above cited. In all species of *Laminaria* examined by the author the oogonium consists of one or few cells, and the egg-cell is pressed out from the oogonium before fertilization. The male gametophytes are multi-celled, and each antheridium developed from a terminal cell of the thallus produces each one antherozoid.

**524. Icones pandanorum micronesicarum (III).** (Japanese). Ryôzô KANEHIRA. (Jour. Japan. Bot. **14**, 1938, 170-177, 11 text-figs.).

*Pandanus dubius* and *tetodon* are discussed in detail with illustrations.

**525. New or noteworthy trees from Micronesia XX.** (With Japan. résumé). Ryôzô KANEHIRA. (Bot. Mag. Tôkyô **52**, 1938, 235-241, 4 text-fig.-groups).

*Pandanus dubius* SPRENG., *Embelia palauensis* MEZ, *Premna integrifolia* LINN., *Viticipremna novae-pommeraniae* (WARB.) H. J. LAM, *Melastoma polyanthum* BL., *Finschia micronesica* (KANEH.) KANEH. comb. nov. are contained.

**526. Apetalous *Zinnia elegans*.** (Japanese). K. KASAHARA. (Japan. Jour. Gen. **14**, 1938, 328-329, 2 text-figs.).

In 1935 the author has discovered among a number of stocks of *Zinnia elegans* one with heads made up exclusively of disk-flowers (apetalous). This mutant, submitted to natural pollination, produced the mixed offspring composed of stocks with typical heads, i.e. those with both ligulate and disk-flowers as well as stocks with apetalous heads. Various crossings were performed on these offspring, among which the following are cited. Apetalous  $\times$  apetalous has given rise to apetalous, and apetalous  $\times$  typical or its reciprocal to typical. These results will indicate that apetalous is a pure-breeding recessive, and typical is dominant to apetalous.

**527. Some derivatives formed by the use of X-rayed pollen in an emmer wheat.** (Japanese with English résumé). Yoshiwo KATAYAMA. (Bull. Alumni Assoc. Utunomiya Agric. Coll. **1**, 1938, 1-3, 1 text-fig. group).

On the emasculated flowers of *Triticum dicoccum* stigmas were treated with the pollen which has been X-rayed. The offspring derived from such parent were found to be various in the percentage of their seed production. In highly sterile plants (2-3-5% fertility) the chromosome aberrations, such as  $2n-1$  or  $2n-2$  (normal  $2n = 28$ ) were observed.

**528. Progenies of some intergeneric hybrids among *Aegilops*, *Triticum* and *Aegilotriticum*.** Yoshiwo KATAYAMA. (Japan. Jour. Bot. **9**, 1938, 335-351, 5 text-figs. and 8 tables).

**529. Künstliche Erzeugung haploider und triploider Einkornweizen durch Bestäubung mit röntgenbestrahlten Pollen.** (Japanisch m. deutsch. Zfg.). Hitoshi KIHARA und Kosuke YAMASHITA. (S. A. aus Commemoration Papers on Agronomy prepared in Honour of Prof. Masao AKEMINE on the Occasion of the thirtieth Annivers. of his academ. Service etc., 1938, 10-20, 9 Textfig. gruppe).

Aus den mit röntgenbestrahlten Pollen bestäubten Blüthen von *Triticum monococcum* sind ausser den diploiden Pflanzen je eine haploide und eine triploide Pflanze erhalten, deren Fruchtbarkeit bedeutend niedriger als bei den diploiden ist. Bei der triploiden Pflanze sieht man bei der I. Metaphase der Pollenmutterzellenmeiose eine Anzahl von uni-, bi- und trivalenten Chromosomen. Eine aus der triploiden Pflanze hervorgekommene einzige Pflanze war zwergig und ganz steril. Bei der haploiden Pflanze war der Pollen selten normal. Sie wurde mit normalem Pollen bestäubt (Rückbestäubung), wobei nur die 7-chromosomigen ♀-Gonen die entwicklungsfähigen Nachkommen ausgegeben haben.

Nach der Ansicht der Verff. dürfte die Bildung der haploiden Pflanze der parthenogenetischen Entwicklung des Eikernes zu verdanken sein, wenn das Endo-

sperm durch die Kopulation der Pollenkerne mit einem Spermakerne erzeugt werden müsste. Der 3x-Embryo der triploiden Pflanze dürfte durch die Verschmelzung eines sich teilenden Eikernes und eines Spermakernes entstanden sein.

**530. Symbolae iteologicae V.** Arika KIMURA. (Sc. Rpts., Tôhoku Imp. Univ. IV. Ser. 13, 1938, 71-83, 4 pls. and 6 text-figs.).

The following plants are new and described with illustrations:  $\times$  *Salix Ikenoana* hyb. nov. (= *E. integra* THUNBERG  $\times$  *S. sachalinensis* SCHMIDT), *S. futura* SEEMEN var. *rufa* var. nov., *S. rupifraga* KOIDZUMI var. *eriocarpa* var. nov., *S. chaenomeloides* nom. nov. (Syn. *S. subfragilis* "ANDERSSON" MATSUMURA, var. *pilosa* (NAKAI) comb. nov.) (Syn. *S. glandulosa* var. *pilosa* NAKAI), *S.* subgenus *Protitea* sec. Madagascarienses sec. nov.

**531. Hypericum japonicarum descriptio. I.** (With Japan. résumé). Yojiro KIMURA. (Bot. Mag. Tôkyô 52, 1938, 188-195, 5 text-figs.).

*Hypericum oliganthum* FR. et SAV. var. *typica* KIMURA with 5 new forms, var. nov. *kusiana*, var. nov. *Muraiana*, *H. Yamamotoi* MIYABE et KIMURA var. *osimense* var. nov., *riparium* var. nov., *H. hyuga-montanum* sp. nov., *H. conjunctus* sp. nov., var. *longistylum* var. nov., *H. erectum* THUNB. var. *angustifolia* var. nov., var. *papillosum* var. nov., *H. ovalifolium* KOIDZ. var. *typica*, var. *Hisauchii* var. nov.

**532. Chromosomenzahlen in den Gattungen Panicum und Setaria. I. Chromosomenzahlen einiger Setaria-Arten.** Enko KISHIMOTO. (Cytologia 9, 1938, 23-27, 3 Textabb.).

Bisher wurden gewisse *Setaria*-Arten mit  $2n = 18$  (diploid), 36 (tetraploid) und 54 (hexaploid) Chromosomenzahlen aufgefunden. Der Verf. hat ausser solchen bei *S. geniculata* eine oktoploide Art ( $2n = 72$ ) aufgefunden. Es ist merkwürdig, dass die Pollengrösse, so zu sagen, der Chromosomenzahl entspricht, so z.B. bei *S. italica* ( $2n = 18$ ), *S. Faberri* ( $2n = 36$ ), und *S. geniculata* ( $2n = 72$ ) beträgt der Durchmesser des Pollens durchschnittlich ungefähr 34, 46 bzw. 56.

Einige morphologische Eigenschaften, welche die obigen verschiedenchromosomigen äusserlich unterscheiden lassen (Borstenfarbe, Deckspelzenmuster), sind hervorgehoben.

**533. Expositiones plantarum novarum orientali-asiaticarum 3.** (With Japan. résumé). Siro KITAMURA. (Acta Phytotax. et Geobot. 7, 1938, 63-71).

The following new species belonging to the Compositae are described: *Artemisia Saitoana*, *A. Tsuneoi*, *Chrysanthemum cuneifolium*, *C. wakasaense*. *C. Yoshinagai*.

**534. Les Mutisieae du Japon (I)-(II).** (Principalement en japonais). Siro KITAMURA. (Jour. Japan. Bot. 14, 1938, 293-306, 377-388, 1 fig. dans le texte).

Tribus Mutisieae contient: Subtribus Gerberinae (Genre *Leibnitzia*), Gochnatineae (Genre *Ainsliaea* avec les sous-genres *Dispanthus* et *Eu-Ainsliaea*, et *Perya*). *Perya Suzukii* est décrite comme une nouvelle espèce avec une figure.

**535. Brief synopses of the classes of Pteridophyta with special reference to the new class Palaeophyllariae.** (Japanese). Gen'iti KOIDZUMI. (Acta Phytotax. et Geobot. 7, 1938, 1-13, 8 text-figs.).

According to the author's view the Pteridophyta should be divided into 7 following classes in accordance with the present state of science, viz. Psilophytariae, Psilotariae, Equisetariae (Articulatae), Palaeophyllariae, Lycopodariae (Lepidophyta), Isoetariae, and Filicariae.



tribes should be treated as two special subfamilies, and further the latter subfamily should contain three tribes, viz. Epimediaceae, Achlyaceae and Ranzaniaceae.

**540. Behaviour of chromonemata in mitosis. VII. A chromosome study by the artificial uncoiling method of the chromonema spirals.** Yoshinari KUWADA. (Cytologia **9**, 1938, 17-22, 1 text-figs. group).

By means of the artificial uncoiling of the chromonema spirals, the result obtained in the previous investigation that the metaphasic doubleness of the spiral shows a condition of the sister chromatid spirals being closely appressed into each other, was confirmed. A peculiar phenomenon noticed by SHINKE that the sister chromatid major spirals are intertwined to form a pair of relational spirals is reported, and an interpretation of the phenomenon on its occurrence and fate is attempted. Author.

**541. Behaviour of chromonemata in mitosis. VIII. The major spirals in diakinesis.** Yoshinari KUWADA and Takeshi NAKAMURA. (Cytologia **9**, 1938, 28-34, 5 text-figs.).

In this paper it is reported that in *Trillium* the diakinesis chromosomes which appear at first sight to be of the reticulate structure are in reality of the coiled structure. It is discussed that the result of observation obtained by one of the author (N) with crossed nicols is regarded as being in accord with that obtained by direct observation.

**542. Divisiones et plantae novae generis *Hosta* (II).** (With Japan. résumé). Fumio MAEKAWA. (Jour. Japan. Bot. **14**, 1938, 45-49, 3 text-figs.).

The following new species and varieties are described: *Hosta clavata*, *H. rectifolia* var. *chionea*, *H. densa*, *H. sacra*. For the latter new species a new section Intermediae was established.

**543. A new classification of *Hosta*. (Preliminary note).** (Japanese with Latin diagnoses). Fumio MAEKAWA. (Bot. Mag. Tôkyô **52**, 1938, 40-44, 3 text-figs.).

A new classification of *Hosta* by the author runs as follows: *Hosta* TRAUTINICK. Subgenus Gibosi F. MAEKAWA

- 1) Sec. Bryocles (SALISB.) ENGLER emend.
  - a) Subsec. Eubryocles F. MAEKAWA
  - b) „ Nipponosta F. MAEKAWA
- 2) Sec. Lamellatae F. MAEKAWA
- 3) „ Tardanthae F. MAEKAWA
- 4) „ Stoloniferae F. MAEKAWA
- 5) „ Picnolepis F. MAEKAWA
- 6) „ Foliosae F. MAEKAWA
- 7) „ Intermediae F. MAEKAWA
- 8) „ Rhynchophoreae F. MAEKAWA
- 9) „ Helipteroides F. MAEKAWA
- 10) „ Niobe F. MAEKAWA

**544. An unusual mode of transmission of a certain tobacco virus disease somewhat closely related to leaf curl or kroepoek.** Takashi MATSUMOTO. (Trans. Nat. Hist. Soc. Formosa **28**, 1938, 123-137, 2 pls.).

A peculiar disease of the tobacco plant closely related to leaf curl occurring in Africa, India, etc. or kroepoek in Java, is chiefly characterized by the dwarfing of the host plant (often its height being reduced to less than 10 cm) as well as by the



very glossy or lustrous appearance of leaves (presumably as the result of the degeneration of the trichomes and epidermal cells). The author's experiments have shown that the soil is not at all concerned in the transmission of the disease. This takes place readily by keeping healthy leaves in touch with diseased ones for a certain time. It was also experimentally ascertained that when diseased and healthy plants in pots are placed near each other, the transmission of the disease is observed, even when a wire gaze or glass plate is set between them. This fact points out to the dissemination of this virus through air, though how this will take place is now not exactly known. It is remarkable that under humid condition the transmission of the virus is slight, or even does not take place at all.

**545. Bacteriophage in relation to *Bacterium malvacearum* E.F.S.1. Preliminary study.** (With Japan. résumé). Takashi MATSUMOTO and Yasuo HUZIOKA. (Ann. Phytopathol. Soc. Japan **7**, 1938, 193-202, 2 text-figs.).

The bacteriophage relating to *Bacterium malvacearum* was obtained by crushing leaves of diseased cotton, adding ten times water, and placing the whole under 10°C during three weeks. The potency of the lytic principle of the phage thus obtained was as follows: the filtrate of three passages has given the titre of  $10^{-7}$  and also a loopful of 1/100 diluted filtrate (the seventh passage) has produced four plaques and the same amount of 1/10 filtrate 109. The potency of the lytic principle was most active between 25-28°, and the maximum at some 37°. During the phagic culture some strains which are highly resistant to the lytic action of the phage begins to appear, though the pathogenicity does in no way differ from the ordinary strains.

**546. Bacteriophage specific for *Bacillus aroideae*.** Takashi MATSUMOTO and Yoza SAWADA. (Trans. Nat. Hist. Soc. Formosa **28**, 1938, 247-256).

The bacteriophage relating to *Bacillus aroideae* TOWNSEND was got from the water suspension of crushed diseased radicles kept at 10° C for some 2 weeks. It was specific in its action, being active only against *Bacillus aroideae* and its homologous bacteria. The potency of the lytic principle was found to be most active at some 25° C. The plaques produced by the phage are very small, being 0.1-1.0 mm, when cultured in neutral potato dextrose agar, which is most suitable for plaque formation.

**547. Genetische Studien bei *Amaranthus tricolor* L. II. Weitere Untersuchungen über Blattfärbung.** (Japanisch m. deutsch. Zfg.). Seiji MATSUMURA. (Japan. Jour. Gen. **13**, 1938, 289-305, 1 Farbentaf. u. 4 Textfig.).

Der vorliegende Aufsatz ist die Mitteilung der Fortsetzung des Verfs. Experimente, welche in diesem JOURNAL **8**, 55, Nr. 227 referiert worden sind.

Die Kreuzung von zwei Genotypen von *Amaranthus salicifolia* ( $R_s R_{st}$ ) und *A. tricolor* ( $r_{rtt}$ ) wurde ausgeführt, wobei die  $F_2$ -Spaltung 12 rot: 3 tricolor: 1 gelb gegeben hat ( $F_1 = R_{st} r_{tt}$ ), aber in einigen Fällen geschah die  $F_2$ -Spaltung in etwas anderer Weise, indem dabei eine trifaktorielle Spaltung zu 36 rot: 9 tricolor: 19 ungefärbt (ohne rote Färbung) gesehen wurde. Diese letztere Spaltung rührt davon her, wie die mikrochemische Studien gelehrt haben, dass ein Chromogengen C zu c mutiert hat, weshalb der soeben genannte  $F_1$ -Bastard  $Cc R_{st} r_{tt}$  sein soll, wobei C und  $R_s$  zueinander komplementär sind.

Unter den soeben referierten  $F_2$ -Individuen unterscheiden sich alle cc-Pflanzen von denen mit C durch das Fehlen der hellroten Farbe im Keimstengel. Weiter sind

die cc-Pflanzen (grün und grüngefleckt) grösstenteils im jungen Stadium zugrunde gegangen, und wenige überlebende waren zwergig und schwach.

Der Verf. hat eine Mosaikpflanze (CcRRTT oder CcRrTT), mit grüngefleckter Streifung auf einem rot-tricolor Grunde bekommen, was nach der Ansicht Verfs. einer somatischen Mutation C→c in diesem Genotypus zu verdanken sein soll.

**548. Wirksamkeit des Photoperiodismus und der Jarowisation zum Aehren-schieben des Weizens und der Gerste.** (Japanisch). Seiji MATSUMURA. (Bot. & Zool. 6, 1938, 1141-1142).

Verf. hat bei Weizen und Gerste den Effekt der photoperiodischen Behandlung und Jarowisation sowie denselben ihres Zusammenwirkens untersucht. Danach sieht man bei beiden Pflanzenarten den beschleunigenden Effekt des Aehrenschiebens, entweder dank einer von diesen zwei Behandlungsmethoden oder den zwei kombinierten. In dieser Hinsicht war die photoperiodische Behandlung erfolgreicher als die Jarowisation, wenn bei Gerste der Effekt der letzteren Methode sehr erfolgreich war. Betreffend Weizen kann man sagen, dass gewöhnlich je später das Aehrenschieben ist (d.h. weniger chromosomig), desto grösser der beschleunigende Effekt der Behandlung war.

**549. Weitere Untersuchungen über die pentaploiden *Triticum*-Bastarde VIII. Die Entwicklung der verschiedenenchromosomigen Endospermen in den Rückkreuzungen des Bastards *T. polanicum* × *T. spelta* zu den Eltern.** Seiji MATSUMURA. (Japan. Jour. Bot. 9, 1938, 259-275, 5 Textabb. u. 5 Tab.).

**550. Chromosome studies on *Trillium kamschaticum* PALL. VI. On the nucleolus-chromosome relationship.** Hajime MATSUURA. (Cytologia 9, 1938, 55-77, 1 text-figs. group).

In *Trillium kamschaticum*, there are neither satellited nor secondary-constricted chromosomes in its complement, presenting an exceptional case to the inference from the SAT-chromosome hypothesis of HEITZ. In the present article, it was shown that in this plant the development of nucleoli is related to the particular ends of particular chromosomes, viz., both distal ends of chromosome A and the distal end of the short arm of chromosome E. This conclusion has been reached from studies on root-tip mitosis, normal and abnormal meiotic divisions and pollen-grain mitosis. It was also shown from observation on abnormal meiotic divisions that every chromosome of a complement is provided with functional activity for nucleolar development, which comes to express itself in particular conditions.

In contrast to *Trillium*, *Paris hexaphylla* was found to be of the SAT-chromosome type, as would be expected from the fact that in it chromosome D is satellited.

From these findings, a hypothesis on the origin of satellited chromosomes was presented. Author.

**551. Chromosome studies of *Trillium kamschaticum* PALL. VIII. Additional evidence for the neo-two-plane theory of bivalent constitution.** Hajime MATSUURA. (Cytologia 9, 1938, 78-87).

Two evidences are presented for the author's neo-two-plane theory (see No. III of this series in this JOURNAL 9, (122), No. 409). One is given from a statistical treatment on chromosome configuration in the precocious type of meiosis in *Trillium kamschaticum*, and the other from a statistical study on meiotic metaphase configuration and anaphase separation of a heteromorphic pair in *Paris hexaphylla*. The data given in this article are not explainable on the chiasma-type theory of DARLINGTON. Author.

**552. Chromosomenstudien an Orchidazeen. I. Karyotyp und Mixoploidie bei *Cephalanthera* und *Epipactis*.** Tadamasa MIDUNO. (Cytologia 8, 1938, 505-514, 1 Taf. und 8 Textfig.).

Bei einigen Arten von *Cephalanthera* und *Epipactis* wurden die folgenden Karyotypen festgestellt ( $2n$ ,  $L$  = lang,  $s$  = kurz,  $L^t$  = lang mit Trabant): *Cephalanthera falcata* und *erecta*  $6L + 28s = 34$ , *C. Shizuoi*  $6L + 26s = 32$ , *Epipactis Thunbergii*  $6L + 34s = 40$ , *E. Sayekiana*  $6L + 2L^t + 32s = 40$ .

Die tetraploiden Zellen wurden oft aufgefunden, deren Entstehung der Vereinigung von Kernen zurückzuführen sein soll, da z.B. oft eine Zellmembran zwischen beiden Tochterkernen nicht oder nur unvollkommen ausgebildet ist und die letzteren zueinander sehr nahe gelegen sind. Bei *C. Shizuoi* und *Sayekiana* kommen beide diploide und tetraploide Zellen in verschiedenen Teilen der Wurzel gemischt vor (Myxoploidie). Wenn die Unterscheidung zwischen den tetraploiden und diploiden Zellen sehr schwierig sein mag, so doch hat der Verf. hauptsächlich die Zahl der Nukleolen für diesen Zweck benutzt.

**553. Contributions to the flora of Northern Japan IX, X, XI.** (With Japan. résumé). Kingo MIYABE and Misao TATEWAKI. (Trans. Sapporo Nat. Hist. Soc. 15, 1937-38, 41-51, 128-139, 203-211, altogether 10 text-figs.).

The three papers above cited contain among other the description of the following new species: *Melandryum hidaka-alpinum*, *Sasa Ishiharae*, *Sasamorpha lasioclada*, *Amitostigma Hisamatsui*, *Betula Yoshimurae*, *Cerastium mitsumorense*, *C. Tatewakii*, *Bupleurum Yokoyamae*, *Trillium amabile*, *Saxifraga Yoshimurae*, *Astragalus yezoensis*, *Adenophora Ishiyamae*, *A. Yokoyamae*.

**554. Studies on the gametophyte of ferns (III). On the prothallium of *Polystichum aculeatum* ROTH var. *taiwanense* NAKAI et MOMOSE and *Leptogramme totta* J. SMITH. Shizuo MOMOSE.—(IV). On the prothallium of *Diplazium Thunbergii* NAKAI and *Diplazium latifolium* MOORE.** By the same author. (Jour. Japan. Bot. 14, 1938, 55-63, 4 text-figs.; 205-273, 6 text-figs.; 407-420, 13 text-figs.).

The prothallium of *Polystichum aculeatum* var. *taiwanense* is characterized as follows: slenderly cordate, cuneately incurved at the apex, both wings fully expanded and wavy at their margin, the median zone band-shaped and beset with the antheridia which attain near to the archegonial part. The prothallium of *Leptogramme totta* which is also cordate as in the former species is somewhat roundish in its outline, with its two wings approaching towards each other and touching near the growing point. In this species the antheridia are distantly placed from the archegonial portion in contrast to what is seen in the former. In the two species of *Diplazium* indicated in the title the prothallium is roundish-cordate, and its two wings are approaching towards each other near the growing point; the median zone is broadly obovate.

The author has studied the prothallium in 10 species of *Dryopteris* belonging to the subgenus *Eudryopteris*. They are generally similar to each other, but each of them presents some characteristics, by which they may be distinguished from each other. Thus, for instance, the tapering end of the prothallium is either cuneate or roundish, the glandular processes which are club-shaped are either not (or at most slightly) swollen at their upper extremities or so considerably swollen there to be called capitate, the cells composing the prothallium body may be either large or small, the cells composing its wing border which is distant from the growing point are either concave or convex outwardly, the central cell of the antheridia containing

the spermatozoids is either pentagonal or tetragonal, those of the archegonial neck are either four-rowed as the general rule or two or three-rowed. Basing on several characteristics above indicated the author has distinguished four different types of *Eudropteris prothallium*.

**555. Eine theoretische Betrachtung über die Infiltrationsmethode.** Masami MONZI. (Bot. Mag. Tôkyô, **52**, 1938, 300-311, 3 Textfig.)

Zunächst beschreibt der Verf. einen Modellversuch, der mit einer Glaskapillare, in deren einem Ende ein schmaler Kapillarchen eingesteckt ist, ausgeführt wurde. Daraus wurde eine neue Formel über die durch das eingesteckte Kapillarchen in die Kapillare aufsteigende Wassermenge auf Grund des POISEULLschen Gesetzes abgeleitet. Die Formel sagt: die Wassermenge ist unter gleichen Versuchsbedingungen proportional zur vierten Potenz des inneren Radius des eingesteckten Kapillarchens. Auf die am *Impatiens*-Blatt vor sich gehende Infiltration des Benzols und Äthers findet auch die genannte Formel eine gute Anwendung: genau gesagt, die Infiltrationszeit ist beinahe dem Quadrat des Produktes der Länge und Weite der Spaltöffnung umgekehrt proportional. Nun hebt der Verf. mit Recht hervor, dass man mit der Quadratwurzel der Infiltrationszeit die durchschnittliche Spaltöffnungsweite des Versuchsblattes in kurzer Zeitspanne leicht und ziemlich genau werten kann.

Verf.

**556. Beeinflussung der Spaltöffnungsweite durch plötzliches Wasserabsperren und -zuführen, mit besonderer Berücksichtigung der Spaltöffnungsbewegung zur Regenzeit.** Masami MONZI. (Japan. Jour. Bot. **9**, 1938, 313-334, 4 Textfig. u. 12 Tab.).

**557. Cytogenetic studies on the genus *Linum*. 1. Conjugation of chromosomes in the hybrids of perennial *Linum* species.** (Japanese). Masato NAGAO. (Rpt. from Commemoration Papers on Agronomy prepared in Honour of Prof. Masao AKEMINE on the Occasion of the thirtieth Anniversary of his academic Service, etc., 1938, 113-119, 13 text-figs.).

The crossing between *Linum perenne* ( $n=9$ ) and *L. alpinum* ( $n=18$ ) gives the triploid hybrid containing  $2n=27$ . In the heterotypic meiosis of PMC the uni-, bi- and trivalents appear in various ratios, thus, for instance,  $4_{III}+6_{II}+5_I$ ,  $4_{III}+6_{II}+3_I$ , etc. In the last stage of this division many small nuclei, each containing one chromosome are found scattered in cytoplasm, as it is often the case in the meiosis of other triploids. The homotypic division gives rise to diads, triads and tetrads. The last part of the present paper is dedicated to the hypothetical discussion of the chromosome pairing: the author thinks that the conjugation of non-homologous chromosomes contained in one and the same genom may take place.

**558. On a strain of sterile rice-plant with open glumes.** (Japanese). Masato NAGAO. (Agric. & Hort. **13**, 1938, 521-530, 4 text-figs.).

Two mutants have appeared in 1933 among the strain of rice-plant known by the Japanese name "Kitamurawase". They are distinguished from the original strain by the fact that the glumes which have opened during the flowering time will not shut again completely, such flowers amounting to 70-80% for each panicle. Their sterility is pretty high, being higher than 50%, though the fertility of the original strain is higher than 70%. The grains of the mutants are small and irregular in shape. The pedigree culture experiments during three successive years have shown that all these characters just mentioned, viz. open glumes, high sterility, irregular shape of grains are inherited. This inheritance is due to the factor which the author



calls pM, though whether pM is really a single factor or a compound of intensely linked factors is unknown. pM is recessive to PM, the corresponding factor in the original strain, and the segregation was found to be monogenic. The transformation PM→pM or the reverse is often seen, though the latter mutation takes place more frequently than the former.

**559. Duration of the preservation of the fertilization possibility in pollen and stigma of rice-plant.** Masato NAGAO and Taneo TAKANO. (Rpt. from Commemoration Papers on Agronomy prepared in Honour of Prof. Masao AKEMINE on the Occasion of his thirtieth Anniversary of his academic Service, etc., 1938, 88-92, 2 graphs).

Stigma of the rice-plant was pollinated with fresh pollen in the same day as or 1-7 days after the emasculation. It was seen that the pollination after 1 day is most effective (81.2% fertility). Next comes that in the same day (65.71% fertility). In that after 2 and 3 days the fertility much decreases, and in that after 4 days it decreases very considerably (9.09%) till to that after 7 days, when it becomes 0.

Similar experiments were executed, and the pollen tube production in the stigma was traced by the use of cotton blue solution. The results are in accord with those of the pollination experiments above cited: in the case of pollination in the same day as and 1 day after the emasculation the production of pollen tubes was observed to be most conspicuous, descends gradually in that after 2-3 days, and was very feeble in that after 4-5 days.

Pollen of different age was applied to the stigma of flowers emasculated last evening. Pollen immediately taken out from the burst anther is most efficacious, as seen from the percentage of the grains in the ripening stage; that after 5 minutes loses already very much its fertilizing power, and no fertilizing power at all is observed in pollen taken after 30 minutes. In similar experiments the germination percentage of pollen of different age was examined, and the results correspond to those of the above experiments: the germination power is greatest in pollen after 1 minute (76%), very feeble in that after 5 minutes (5%), much more feeble in that after 30 and 60 minutes (4 and 2% respectively).

**560. On the developmental change of quantities of chlorophyll and carotinoid in the leaves of rice-plant, barley, and wheat.** Hideo NAGASIMA. (Japan. Jour. Bot. 9, 1938, 277-296, 17 text-figs. and 6 tables).

**561. Two new species of Japanese and Korean rubiaceous plants, together with the remarks on some noticeable East-Asiatic species.** Takenoshin NAKAI. (Jour. Japan. Bot. 14, 1938, 113-122).

For the identificatin of the three species, *Rubia chinensis* REGEL et MAACK, *R. pedicellata* NAKAI sp. nov. and *R. mitis* MIQUEL an analytical key is given. *R. mitis* forma *typica* and *glabrescens* are distinguished, and *R. pedicellata* is provided with a diagnosis.

In the next place the author gives some notes on *Asperula*, of which the following are new: *A. Maximowiczii* KOMAROV var. *typica*, var. *latifolia*, var. nov., *A. lasiantha* sp. nov.

**562. On the Japanese species of *Melothria*.** (Japanese with Latin diagnoses). Takenoshin NAKAI. (Jour. Japan. Bot. 14, 1938, 122-131, 1 text-fig.).

Of seven Japanese species of *Melothria*, the following is described as a new species, viz. *M. liukiensis*.



When wheat suffers from wheat blight or scab caused by *Gibberella Saubinetii*, the germination of grains is much disturbed, and the germinating seeds are attacked. So that the safest way is to sow disease-free seeds collected in healthy fields. But as for various reasons this is often hardly possible in practice, the authors have described in this paper the so-called specific gravity method. By resorting to this method one can select out even on diseased plants the grains which are not only able to well germinate, but also show no internal hyphae. The method consists in using the watery solution of magnesium chloride with sp. gr. 1.00–1.24, and soaking the grains in this solution. According to the authors' experiments on a great number of wheat varieties seeds heavier than 1.24 in sp. gr. were found to germinate very well, and show no internal hyphae. The authors conclude that even the wheat grains developed on diseased plants may be sown without anxiety to get the next generation, if they are greater than 1.20 or 1.24 in sp. gr. In such case the surface disinfection should be done, since it will not be excluded that accidentally some fragments of the hyphae as well as the spores of the causal fungus are adhering to their surface.

**574. Studies on the temperature relations to the longevity of pure culture of various fungi pathogenic to plants.** Yosikazu NISIKADO, Kôdi HIRATA, and Tatuo HIGUTI. (Ber. Ôhara Inst. landw. Forsch. **8**, 1938, 107–124, 11 tables and 4 graphs). (The paper on the same subject written in Japanese in Agric. Studies **29**, 1938, 324–348, 12 tables and 4 graphs).

A certain number of pathogenic fungi belonging to various groups were cultured on potato decoction-, malt extract-, or rice straw decoction-agar, and concerning such cultures the fact, how long they may survive under various temperatures varying from 0° to 35° C was studied. The fungi taken up in the author's experiments were as follows: *Phytophthora melongenae* (Phycomycetes), *Hypochnus centrifugus* and *H. Sasakii* (both Basidiomycetes), *Cerastomella piceae*, *C. pini*, *Gibberella Saubinetii*, *G. Fujikuroi*, *Pyrenophora graminea*, *Ophiobolus Miyabeanus*, *Sclerotium trifolium* (above eight Ascomycetes), *Cephalosporium gramineum*, *Ceratospora Kaki*, *Fusarium niveum*, *Helminthosporium nodulosum*, *Macrosporium porri*, *Piricularia oryzae*, *P. zingiberi*, *Septoria lactucae* (above eight Fungi Imperfecti).

The results of the authors' observations are summarized in several tables and graphs in detail. The chief results, as indicated in the authors' summary, are as follows: All pathogenic fungi above cited, except *Phytophthora melongenae*, are able to live some three years under 0–15°, though some difference of longevity may exist between them. In *Phytophthora melongenae* and *Piricularia oryzae* the longevity becomes shortened parallel to the rise of temperature, thus, for instance, under 20–25° they stop to live already after 10–12 months. Under 30° *Gibberella Fujikuroi*, *Ophiobolus Miyabeanus*, *Helminthosporium nodulosum* were found to live during 28–29 months, while *Hypochnus centrifugus*, *Macrosporium porri*, and *Septoria lactucae* were observed to retain their life only during 3–5 months. Under 35° *Helminthosporium nodulosum* was able to survive 16 months, while all others were seen to die after 1–5 months.

As to the influence of low temperature *Piricularia oryzae* was found to be able to live only 1–2 months under 0° and 3–4 months under 5°. Similarly, *Phytophthora melongenae* dies after 2 months under 0–5°.

It may be added that the temperature relation of pure cultures above cited does show no difference in different nutrient media used for the culture.

**575. Notes on Japanese Musci (I)–(II).** (With Japanese résumé). Akira NOGUCHI. (Jour. Japan. Bot. **14**, 1938, 25–32, 397–406, altogether 11 text-figs.).

Among 7 species enumerated the following are new and described with illustrations: *Coscinodon humilis*, *Enthodon rigidus*, *E. morrisonensis*, *Ditrichum formosicum*, *Bartramia alpicola*, *B. morrisonensis*.

**576. Symbolae ad floram Asiae Orientalis 16.** (With Japanese résumé). Jisaburo OHWI. (*Acta Phytotax. et Geobot.* **7**, 1938, 29-38).

The following new species are described: *Vitex iriomotensis*, *Alangium premnifolium*, *Carex genkaiensis*, *C. dissitispicula*, *Lecanorchis brachycarpa*, *Leersia Sayanuka*, *Setaria ferruginea*, *Erianthus Kanashiroi*.

**577. On some Japanese species of the ranunculaceous plants.** (Japanese with Latin diagnoses). Jisaburo OHWI. (*Acta Phytotax. et Geobot.* **8**, 1938, 43-48).

The following new species are described: *Clematis papuligera*, *C. austrojaponensis*, *C. crassisejala*, *Anemone chosenicola*, *Aconitum Saitoanum*.

**578. A propos des fleurs cléistogames de l'Euryale ferox.** (En japonais). Yonosuke OKADA. (*Études écologiques* **4**, 1938, 159-168, 5 figures dans le texte).

Il est bien connu que l'*Euryale ferox* porte en général des fleurs cléistogames, dont l'extrémité supérieure s'élève pendant la floraison sur l'eau où vit la plante. En ce temps-là le calice composé de quatre sépales s'ouvre si légèrement, que l'on ne puisse apercevoir extérieurement qu'une petite portion de la corolle, ni étamines, ni pistils y renfermés n'étant visibles du tout. Au contraire, chez les fleurs chasmogames qui sont produites fort rarement, la corolle qui est beaucoup plus grande que chez les fleurs cléistogames s'ouvre pendant la floraison si largement, qu'on puisse voir les étamines et les pistils en dedans de cela sans aucune peine. La comparaison des fruits et graines engendrées par les fleurs cléistogames d'un côté et les chasmogames d'un autre nous fait connaître que le fruit venant de la première espèce de fleur citée ci-dessus est beaucoup plus grand, plus développé et plus lourd que celui venant de la seconde. Quant aux graines y renfermées quelques auteurs ont pu obtenir même sur les fleurs chasmogames quelques-unes de bonne qualité, tandis que les autres n'en ont eu rien qui ont le pouvoir de germer. Citons un exemple annoncé par le présent auteur: un fruit engendré par une fleur cléistogame a donné 114 graines bien parfaites et seulement 3 qui sont imparfaitement développées, tandis que sur un autre venant d'une fleur chasmogame il y en avait 117 graines, dont toutes sont imparfaitement développées.

**579. On the specific name of the Asiatic cotton distributed in Eastern Asia.** (Japanese). Zirô ONODERA. (*Proc. Crop Sc. Soc. Japan* **10**, 1938, 5-25, 1 text-fig.).

The author makes first of all the review of the mode of classification of the *Gossypium* species by various authors (LINNÉ, WATT, HARLAND, GAMMIE). He then proceeds to express his own view on East-Asiatic cotton, which is based on his culture experiments of cotton coming from various parts of Asia, viz. Persia, India, Birma, Siam, Cochinchina, China, Korea and Japan. He thinks that the newest classification of HARLAND accords best with his own experience. According to him there is no *Gossypium herbaceum* in Eastern Asia, and the cotton widely cultivated there should be regarded as *G. arboreum* var. *neglectum* forma *burmanica* H. et G.

**580. On the influence of the day length on the development of flower buds in cotton.** (Japanese). Zirô ONODERA. (*Proc. Crop Sc. Soc. Japan* **10**, 1938, 26-31, 3 text-figs.).

A number of the cotton strains collected from various parts of Asia were cultivated in Ryûkô, Korea (N. L.  $39^{\circ} 46'$ ). Among these the species from low latitude have made a vigorous vegetative growth, but were not able to produce seeds. The author could observe that the flower buds produced in long summer days stop to grow soon after their formation and fall down, while those produced later when the day length will be shorter, will develop better in spite of low temperature (cotton from India, Malay Peninsula, Cochinchina, Formosa). Basing on such observations he has performed on various species derived from the countries of low latitude the short day photoperiodic culture: he has placed his culture in darkness during a number of hours, so as to make the duration of illumination of Ryûkô (where his culture was done) equal to that of the region at N. L.  $20^{\circ}$  (so, for instance, in late June, the day length in Ryûkô amounts to 14 hrs. 53 min., while in the region of N. L.  $20^{\circ}$  it amounts to 13 hrs. 8 min.; difference = 1 hr. 35 min.). By means of such short day photoperiodic procedure the author has succeeded to let cotton of low latitude form the capsules in his experimental field in Ryûkô.

The results of the author's experiments may be summarized as follows: In *Gossypium arboreum* of low latitude some are able to form the capsules even under natural condition, while some others were unable to form the capsules without the short day photoperiodic treatment. In *Gossypium herbaceum* and *G. hirsutum* the capsule formation is impossible under natural condition.

**581. Ueber die Chromosomenzahl einiger Asparagusarten.** (Japanisch). Masazi OSAKA. (S.A. aus "Commemoration Papers in Agronomy prepared in Honour of Prof. Masao AKEMINE on the Occasion of the thirtieth Anniversary of his academic Service, etc., 1938, 187-190, 10 Textfig.).

Verf. hat die Chromosomenzahl in den Wurzelspitzen sowie PMZ von 9 *Asparagus*-arten gerechnet, unter denen bei  $6 \cdot 2n = 20$  nachgewiesen ist. Eine Art unbekanntes Namens zeigt 40 somatische Chromosomen und ist daher als tetraploid zu bezeichnen. *A. Sprengeli* lässt ca 60 somatische Chromosomen erkennen und ist somit als hexaploid aufzufassen, in Uebereinstimmung mit KUHN. In allen vom Verf. untersuchten Arten sind immer grosse sowie kleine Chromosomen vertreten. In *A. officinalis* (diözisch) waren keine Geschlechtschromosomen nachweisbar.

**582. Preliminary note on the nucleolus and nucleolar chromosome.** (Japanese with English résumé). Kan-iti SAKAI. (Rpt. Commemoration Papers on Agronomy prepared in Honour of Masao AKEMINE on the Occasion of the thirtieth Anniversary of his academic Service, etc., 1938, 161-168, 1 pl. and 12 text-figs.).

A great number of rice varieties are characterized by containing  $2n = 24$  chromosomes. In the Japanese varieties belonging to the subspecies Japonica the author has found in the somatic telophase two nucleoli, while in the Chinese varieties belonging to the subspecies Indica four nucleoli were seen in the corresponding stage of mitosis, though in the prophase only one nucleolus is visible, which is produced by the fusion of two or four telophasic nucleoli respectively. In the prophase it is remarkable in those varieties containing two nucleoli in telophase (Japonica), 2 out of 24 chromosomes are connected each with the nucleolus (nucleolar chromosome), and in those containing 4 nucleoli in telophase (Indica) 4 nucleolar chromosomes are seen. In the meiotic phase one or two nucleolar bivalents are seen in Japonica and Indica respectively.

An autotetraploid produced spontaneously from Japonica shows 4 nucleoli in somatic telophase, and 4 nucleolar chromosomes or 2 nucleolar bivalents in somatic prophase.

**583. Beobachtungen über japanische Moosflora XVI.** (Mit japan. Zfg.) Kyuichi SAKURAI. (Bot. Mag. Tōkyō **52**, 1938, 129-135, 7 Textfig., 165-166).

Die folgenden Arten sind als neue beschrieben: *Ditrichum longipes*, *Dialytrichia fragillima*, *Clasteryum macrothamnioides*, *Helicodontium japonicum*, *Hondueella aulacophylla*, *Vesicularia ochracea*.

**584. Trivial notes on Japanese plants. (III)-(IV).** (Japanese with Latin diagnoses). Yoshisuke SATAKE. (Jour. Japan. Bot. **14**, 1938, 196-204, 4 text-figs.).

Part III contains besides some notes on *Hemerocallis exilis* SATAKE and on the akenes of *Boehmeria gigantea* SATAKE the description of the following plants, viz. *Viburnum amplissimum* sp. nov., *V. Sieboldii* MIQUEL var. *longifolium* var. nov. *Boehmeria stenotachys* sp. nov., *B. Hatusimae* sp. nov. Further, the occurrence of *Juncus biglumis* LINN. in the Kurile Isl. is noticed.

Part IV contains the description of *Juncus takasagomontanus*, *J. Tatewakii*, *Luzula elata*, *L. unalaschenensis*, all of which are new species.

**585. Utilization of nitrate- and ammonia-nitrogen by plants VI. On the reaction of nutrient media.** (Japanese with English résumé). Kisaburo SHIBUYA, Hideaki SAEKI and Daizaburo KATAGAI. (Jour. Soc. Trop. Agric. **10**, 1938, 38-54).

Concerning paddy rice the authors have examined, whether ammonia- or nitrate-nitrogen will be much more utilized by it in nutrient media of different pH-reactions. For the culture a somewhat modified KNOP's solutions with pH = 4, 5, 5 and 7 respectively were used, which were renewed every other day. The results of experiments are briefly as follows: Ammonia-nitrogen was much more absorbed and more favourable for the plant growth than nitrate-nitrogen. The influence of the pH-value of nutrient media upon the plant growth as, for instance, culm length and weight, number of tillers and ears, weight of root and grain, was observed to be  $4 > 5, 5 > 7$ . Since both kinds of nitrogen were seen to be taken up more on the acidic side of the isoelectric point than on the alkaline the difference between their absorption at various pH-values will not depend on the isoelectric relation. In short, plants will grow better in ammonia- than in nitrate-nitrogen.

**586. Forcing the germination of dormant seeds by means of growth hormone.** (With Japan. résumé). Tsunetoshi SHIBUYA. (Jour. Soc. Trop. Agric. **10**, 1938, 1-8).

Seeds of peanut were used for experiments, which normally will remain perfectly dormant for three months. To accelerate their germination the heteroauxin ( $\beta$ -indole acetic acid) mixed with lanolin (0.1 gr. and 1 gr. respectively) was used. In the author's experiments the radicle of seeds was at first exposed by removing a part of seed-coat near the micropylé. The experiments were as follows: The lanolin preparation of the hormone was applied to wounded as well as non-wounded radicle. Secondly, lanolin only was applied to wounded and non-wounded radicle. Thirdly, for the sake of control the radicle was neither wounded nor treated with either lanolin or hormone. All these experiments have shown that almost all seeds (90% or even more) have germinated within three weeks, while in those treated with lanolin only or not at all treated at most 40% were seen to germinate after three weeks. It is to be added that neither the wounding nor the treatment with lanolin only can exert any accelerating influence at all on the germination, and further, that the seeds at the upper part of the pod have germinated earlier than those at the lower.



**587. Varietal differences of the reaction against potassium bichromate in tea-plant.** (Japanese with English résumé). Takasi SIMURA. (Proc. Crop Sc. Soc. Japan **10**, 1938, 52-55, 1 text-fig.).

When fresh branches of a tea-plant are cultivated in a solution containing 0.25% potassium bichromate, brown spots begin to appear on leaves after some 48 hours. The author has done experiments on 30 tea varieties, and could observe that the degree of this reaction is different in different varieties. In one and the same variety it is different in different stages of the growth, inasmuch as the younger the leaf and consequently the upper its position on a branch, the stronger was the reaction. Against chromic acid and potassium chromates the tea-plant shows almost similar reaction. The injurious effect of potassium bichromate just referred to is based on its combination with the tannin contained in the plant tissue, so that the more abundant the latter in the tissue, the stronger was the reaction. This reaction is therefore utilizable for the determination of the quantity of tannin contained in any tea leaves.

**588. Diatoms collected by Mr. Yoshikazu OKADA in Nippon. I. Mountain bog diatoms flora from Prov. Sinano.** S. V. SKVORTZOV. (Jour. Japan. Bot. **14**, 1938, 204-217, 2 fig.-groups).

Among 42 diatoms in all about 33% belong to northern and alpine elements, while only one belongs to the tropical one. 11(=24%) are regarded as new, viz. *Eurotia alpina* var. *minor*, *E. monodon* var. *paucistriata*, *E. nipponica*, *Neidium iridis* var. *nipponica*, *Anomoeneis Okadai*, *Pinnularia appendiculata* var. *nipponica*, *P. Sugiurae*, *P. gentilis* var. *subacuta* and var. *sibirica*, *Cymbella sinica* var. *nipponica*, *Surirella delicatissima* var. *nipponica*.

The paper ends with an enumeration of all diatoms investigated and the diagnoses of the new ones.

**589. Studies on the male gametophyte in angiosperms IV. Behaviour of the "droplet-sheath" in the pollen-tube.** Nobuhide SUITA. (Cytologia **8**, 1938, 532-541, 27 text-figs.).

The behaviour of the "droplet-sheath" of the generative cell contained in the pollen-tube (cf. e.g. this JOURNAL **9**, (82), No. 287) of *Crinum latifolium* and *Hippeastrum vittatum* was studied chiefly in the living state. The results are almost identical in both species above named. The droplets are found gathering around the generative cell, forming a spindle-shaped sheath. After the formation of two sperm-nuclei, the droplet-sheath is formed around each of them, and no stable membrane is produced between the two nuclei. No normal cytokinesis follows the mitosis of the generative nucleus. It is to be noticed that the droplet-sheath could be easily stripped off from the nucleus by a certain external influence at the point of death.

**590. Studies on bacteria in the interior of rice seeds. VI. Influence of hydrogen concentration of the culture media of the thermal death time.** (Japanese with English résumé). Hashio SUZUKI. (Ann. Phytopathol. Soc. Japan **7**, 1938, 221-230, 2 graphs).

A certain number of bacteria were cultured in several nutrient bouillon broths at 28° C, pH of each being regulated to 5.0, 7.0, or 8.6. These cultures were suspended in a water-bath at 50°±0.5° C for some time. Concerning 9 strains of *Bacillus* A, 4 of B.B and 2 of B.C thus treated their respective death point was examined. The general conclusion of the author's present experiments was that the thermal death point of bacteria was greatest in the nutrient media of pH 7 than in those of pH 5.0



or 8.6, and consequently the thermal resistance of bacteria seems to decrease with the increase of the pH-value of nutrient media.

**591. *Cyclogramme*, a new fern genus.** (Japanese with Latin diagnoses). Motozi TAGAWA. (Acta Phytotax. et Geobot. **7**, 1938, 49-56).

A new genus *Cyclogramme* was established by the author. A new combination *C. similans* (CHING) TAGAWA should replace *Thelypteris similans* CHING. The following new combinations by the author are enumerated: *C. omeiensis* (BAK.), *C. himalayensis* (C. CHR.), *C. squamastipes* (CLARKE), *C. neo-articulata* (CHING), *C. flexilis* (CHRIST), *C. Chunii* (CHING), *C. khasiensis* (CHING).

**592. *Spicilegium pteridographiae Asiae Orientalis* 15.** (With Japan. résumé). Motozi TAGAWA. (Acta Phytotax. et Geobot. **7**, 1938, 72-87).

The following new species are described: *Trichomanes pseudo-blepharistomum*, *Leptogramme amabilis*, *Cyrtomium taiwanianum*, *C. tukusicola*, *Diplazium triangulare*, *D. agyokuense*, *Asplenium barbarens*, *Pteris Nakasimae*.

**593. Miscellaneous notes on the East-Asiatic pteridophytes with special reference to the Japanese species (V).** (With Japanese résumé). Motozi TAGAWA. (Jour. Japan. Bot. **14**, 1938, 101-112).

The following new species are described among others: *Polystichum spinoscens*, *Tectaria Fauriei*, *Diplazium Kanasiroi*, *Asplenium pseudo-Wilfordii*, *Pteris natiensis*, *Colysis longifrons*.

**594. Alpine flowers of Japan.** Hisayoshi TAKEDA. Publ. Sanseidô Co., Tôkyô 1938. 18×13 cm, 31 pp. text with 18 figs.+101 pls. Price 5 yen.

This little book written by H. TAKEDA, the well-known Japanese alpinist and botanist, will be in all probability much welcomed by those foreigners who are interested in alpine plants in high mountains of Japan. In the introductory part of the book (pp. 1-31) the author describes various plant zones in Japan, and discusses especially the feature and behaviour of alpine plants in Japanese high mountains. Follows then the historical account of cultivation of alpine plants in Japan. The great bulk of the book is occupied by 101 plates, each of which contains the fine photograph of one Japanese alpine plant, due generally to the author himself. To each plant one special page is devoted, where its habit, habitat and mode of cultivation are described.

**595. Zur Theorie der Turgordehnung und über den funktionellen Zusammenhang zwischen den einzelnen osmotischen Zustandsgrössen.** Hiroshi TAMIYA. (Cytologia **8**, 1938, 542-562).

Die Erfahrung, dass die früher von URSPRUNG und BLUM (1916) angenommene Proportionalität zwischen der Zunahme des Turgordrucks und der des Zellvolumens nicht der Wirklichkeit entspricht, führte den Verfasser zur Aufstellung der neuen empirischen Formeln, die zum Ausdruck des wahren funktionellen Zusammenhangs zwischen den einzelnen osmotischen Zustandsgrössen dienen sollen. Bei einer isolierten Zelle mit einer genügend grossen Zentralvakuole und einer genügend dünnen und gegen Osmotika vollkommen semipermeablen protoplasmatischen Schicht gilt nach dem Verfasser folgende Gleichung:

$$\frac{d C_{en}}{d C_{ew}} = \alpha - f(C_i - C_{en}),$$

- worin
- $C_{en}$ : den osmotischen Wert des Zellinhaltes,
  - $C_{ex}$ : den osmotischen Wert der mit der Zelle im Gleichgewicht stehenden Aussenlösung,
  - $C_i$ : den osmotischen Wert des Zellinhaltes sowie der Aussenlösung bei der Grenzplasmolyse,
  - $\alpha$ : den Grenzwert von  $\frac{d C_{en}}{d C_{ex}}$  bei der Grenzplasmolyse,
  - $f$ : den „Festigkeitskoeffizienten“, der für einzelne Zelle eine charakteristische Konstante darstellt,

bedeutet. Unter der Annahme, dass bei parenchymatischen Zellen  $d = 1$  sei, wurde aus der obigen Formel folgende Gleichungen abgeleitet:

$$\begin{aligned}
 C_{en} &= C_i - \frac{1}{f} \left[ 1 - e^{-f(C_i - C_{ex})} \right], \\
 S &= C_{ex} = \frac{1}{f} \ln \left[ f C_{en} - f C_i + 1 \right] + C_i \\
 &= \frac{1}{f} \ln \left[ \frac{f C_i}{\phi} - f C_i + 1 \right] + C_i, \\
 T &= C_i - S - \frac{1}{f} \left[ 1 - e^{-f(C_i - S)} \right] \\
 &= C_{en} - C_i - \frac{1}{f} \ln \left[ f C_{en} - f C_i + 1 \right], \\
 \phi &= \frac{f C_i}{f C_i - 1 + e^{-f(C_i - C_{ex})}},
 \end{aligned}$$

Hierbei bedeutet

- $S$  bzw.  $T$ : die Saugkraft bzw. den Turgordruck der Zelle, deren osmotischer Wert  $C_{en}$  ist,
- $\phi$ : den Grad der Turgordehnung, d.i. das Verhältnis des Zellvolumens bei  $C_{ex}$  zum Zellvolumen bei der Grenzplasmolyse.

Der Festigkeitskoeffizient  $f$  kann dann leicht ausgerechnet werden, wenn das Verhältnis (das Zellvolumen in wassergesättigtem Zustand)/(das Zellvolumen bei der Grenzplasmolyse) und der Wert  $C_i$  zugleich bekannt sind. Zur Prüfung der Gültigkeit der obigen Formeln wurden die experimentellen Daten von H. R. OPPENHEIMER (1930) an der Markzelle von *Taraxacum* sowie diejenigen von I. STOW (1936) an *Nitella*-Zellen herangezogen, wobei ebenfalls schöne Übereinstimmung zwischen den gefundenen und den berechneten Werten bestätigt werden konnte.      Verfasser.

**596. Zur Frage der Nichtidentität der Cytochromoxydase mit dem sauerstoffübertragenden Ferment von O. WARBURG.** Hiroshi TAMIYA und Hideo KUBO. (Acta Phytochim., 10, 1938, 317-334).

Bei näherer Durchmusterung der Verteilungsgleichung des sauerstoffübertragenden Fermentes von O. WARBURG haben die Verfasser gefolgert, dass bei verschiedenen Proben von einer bestimmten aeroben Zelle die Kohlenoxydhemmung der Atmung stets derart eintreten soll, dass folgende einfache Proportionalität zwischen dem Verteilungs-

koeffizienten  $k$  des sauerstoffübertragenden Fermentes und der maximalen, bei Sättigung der Zelle mit  $O_2$  zu beobachtenden Atmungsintensität  $Q_{max}$  besteht.

$$\frac{Q_{max_1}}{Q_{max_2}} = \frac{k_2}{k_1}.$$

Hierbei ist allerdings vorausgesetzt dass erstens bei dieser Zelle der gesamte  $O_2$ -Bedarf des Dehydrasesystems durch die Betätigung des Eisenkatalysatorsystems allein gedeckt wird, und dass zweitens in den beiden Zellproben die Gesamtkonzentration des sauerstoffübertragenden Fermentes dieselbe bleibt, sodass die Verschiedenheit von  $Q_{max}$  nur auf den Unterschied der Wirksamkeit des auf das  $O_2$ -übertragende Ferment „reduzierend“ wirkenden Reaktionssystems zurückgeführt werden muss. An Hand des Acetobacters und der Bäckerhefe wurde bei Veränderung von  $Q_{max}$  durch Zugabe verschiedener Atmungssubstrate sowie durch Zusatz von Aethylurethan als Narkotikum die Gültigkeit der obigen Formel einwandfrei nachgewiesen. Ferner konnten die Verfasser zeigen, dass bei teilweiser Hemmung der Atmung durch Blausäure der CO-Einfluss sich stets in dem Sinne äussert, dass das CN, analog dem Urethan, auch nicht auf das  $O_2$ -übertragende Ferment selbst, sondern auf irgend eine Komponente der darauf „reduzierend“ wirkenden Reaktionskette affizierend wirkt. Da unter den Faktoren in dieser Reaktionskette als CN-empfindlich nur die Cytochrom-c-Oxydase in Betracht kommen kann, ferner, weil diese Oxydase, soweit bis jetzt bekannt, für ihre Wirkung nur den molekularen Sauerstoff als H-Akzeptor in Anspruch nimmt, so wurde darauf geschlossen, dass das  $O_2$ -übertragende Ferment, welches bekanntlich gegen CO empfindlich ist, praktisch gegen CN resistent sein muss, während die Wirkung der Cytochrom-c-Oxydase, welche den molekularen Sauerstoff von dem oxygenierten  $O_2$ -übertragenden Ferment übernimmt, primär nur durch CN aber nicht durch CO verhindert wird.

H. TAMIYA.

**597. Chromosome studies in Cyperaceae. II. *Scirpus lacustris* L.** Nobunori TANAKA. (Cytologia 8, 1938, 515-520, 14 text-fig.).

The chromosome number of *Scirpus lacustris* is  $n = 21$  according to some authors. The present author has studied the chromosome number of the same species, normal as well as two kinds of its variegated strains. One of the latter, called f. *pictus*, is distinguished by the longitudinal white stripes running through the culm, while the other, called f. *zebrinus*, is characterized by the presence of white cross regions in the culm.

The cytological examination of PMC and root-tip cells in normal strain has shown  $n = 19$  and  $2n = 38$  respectively, and it is remarkable that in the former, out of 19 chromosomes 1, and in the latter, out of 38 2 are conspicuously larger than any other, measuring almost thrice the latter. In the root-tip cell of f. *pictus* 40 chromosomes were present, of which one is conspicuously larger than any other, while in those of f. *zebrinus* 42 chromosomes were counted, none being larger than the other. The author thinks that the large chromosome above spoken is a "Sammelchromosom" composed of three small chromosomes, so that if the large and the small chromosomes are indicated by S and s respectively, we have

	n	2n
normal	$19 = 18s + 1S$	$38 = 36s + 2S$
<i>pictus</i>		$40 = 39s + 1S$
<i>zebrinus</i>		$42 = 42s$

Formerly it was stated by some authors that the chromosomal instability due to extra-chromosome or chromosomal fragmentation has led to variegation in flowers or leaves of some plants. The author thinks that the fragmentation of the conspicuously large chromosome in *f. zebrinus* might be the cause of its variegation.

**598. *Phytophthora* rot of lily.** (Japanese with English résumé). Heizi TASUGI and Masatake KUMAZAWA. (Jour. Imp. Agric. Experiment Station, Nisigahara, Tōkyō, **3**, 1938, 207-238, 3 pls. and 3 graphs in text).

The rot disease of *Lilium elegans*, *longiflora* and *davuricum* was recognized to be caused by *Phytophthora parasitica*, and that of *L. auratum* by another fungus, *P. cactorum*.

The symptoms of the disease are quite similar to those of foot stunt rot of lilies reported in U.S.A. and Bermuda.

The morphology and physiology of the two fungi above cited were experimentally studied, and the results are announced in the present paper.

**599. On inheritance of root color in *Raphanus sativus* LINN.** (Japanese with English résumé). Tamio TATEBE. (Japan. Jour. Gen. **14**, 1938, 39-50).

The root color of a Japanese strain of *Raphanus sativus* called Hatukadaikon is various, viz. white, red, purple, yellow and black. On the basis of a number of crossing experiments the author has found the genotypic constitution of various colors as follows:

white....rrBByy, red....RRbbyy, purple....RRBByy, yellow....rrBBYY or rrBbYY, black....rrBBYY.

**600. Heterochromosomen der Lebermoose IV-V.** (Japanisch mit deutsch. Zfg.). Seizi TATUNO. (Bot. Mag. Tōkyō **52**, 1938, 45-51, 93-99, im ganzen 67 Textfig.).

Bei *Preissia commutata* weist man zwei heteropyknotische Heterochromosomen verschiedener Grösse nach (Formel  $9 = 7 + H + h$ ), während bei *Marchantia formosana*, *Conocephalus conicum* und *Fimbriaria liukuensis* es bloss ein  $h$  gibt (Formel  $9 = 8 + h$ ). Bei *Reboulia hemisphaerica*, *Riccia glauca* und *Ricciocarpus natans* beobachtet man bloss ein kleines nicht heteropyknotisches Chromosom (Formel  $9 = 8 + m$ ). Weiter, bei 8 von dem Verf. untersuchten Arten aus der Gattung *Madotheca* steht die Chromosomenformel wie folgt:  $8 = 7 + H$ , während bei 8 von ihm studierten Arten aus Jungermanniales akrogynae die Formel entweder  $9 = 7 + h + h$  oder  $8 = 6 + H + h$  ist.

**601. Ueber die Keimfähigkeit der unter niederer Temperatur aufbewahrten Samen.** (Japanisch). Torao TEJIMA und Giiti MISONOO. (Proc. Crop Sc. Soc. Japan **10**, 1938, 56-64, 6 Textfig.).

Die Keimfähigkeit der unter niederer Temperatur aufbewahrten Samen ist bisher vielfach untersucht worden, doch dabei war die Dauer des Samenbleibens im kalten Raum nicht besonders lang, höchstens einigen Tagen. Die Verff. haben die Samen von Reis, Gerste und Weizen im speziell für die Kälte eingerichteten Zimmer während eines Jahres unter  $-25^{\circ}$  bis  $-35^{\circ}$  gehalten, und dann ihre Wassergehalt sowie Keimfähigkeit untersucht. Die Resultate dieser Experimente, welche von Verff. graphisch dargestellt sind, stehen wie folgt:

Der Wassergehalt der Samen nach einem einjährigen Bleiben im soeben genannten kalten Raum ist verschieden, je nachdem sie im Baumwollsack oder in der Blechbüchse aufbewahrt sind. Im letzteren Falle nimmt der Wassergehalt während dieses Zeitraumes ab, während im ersteren, dagegen, er nach langer Zeit zunimmt. Während die in



gewöhnlicher Weise aufbewahrten Samen nach einem Jahre keimunfähig werden (ausgenommen die  $\pm 10\%$  Wasser enthaltenden Samen) können die im oben genannten Wege kaltgehaltenen Samen nach der gleicher Zeitdauer gut keimen, wenn sie nicht besonders wasserreich sind, ja sogar etwas besser als bei den ersteren. Bei den in der Kälte aufbewahrten Samen wird der Eintritt ihrer Keimung etwas verzögert, im Vergleich zu den in gewöhnlicher Weise aufgehaltenen, doch bei den Reissamen wird er beträchtlich beschleunigt.

**602. New species of parasitic fungi.** Kogo TOGASHI. (Trans. Sapporo Nat. Hist. Soc. **14**, 1936, 280-285, 7 text-figs.).

The following new species of parasitic fungi are described with illustrations: *Irene alpina* TOGASHI et MENTZER (on leaves of *Coptis trifoliata*), *Claviceps yanagawaensis* TOGASHI (on caryopses of *Zoysia japonica*), *Mycosphaerella yanagawaensis* TOGASHI (on leaves and stipes of *Pteridium aquilina* var. *japonica*), *Phyllosticta yanagawana* TOGASHI (on leaves of *Hosta Sieboldiana*), *Septoria cardiocrinii* TOGASHI (on leaves of *Cardiocrinum cordata*), *Colletotrichum puccinifolium* TOGASHI (on leaves of *Hosta Sieboldiana*).

**603. A contribution to the parasitic flora of Mt. Iwate, Iwate Prefecture.** Kogo TOGASHI. (Bull. Imp. Coll. Agric. & Forest., Morioka, **22**, 1936, 61 pp., 6 text-figs.).

The paper enumerates 194 species of parasitic fungi collected by the author in Mt. Iwate (2040.5 m. above sea-level) in Iwate Prefecture. Among them the following are new: *Peronospora Yamadana*, *Puccinia iwateyamensis*, *P. Togashiana*, *Macrophoma quercicola*, *Phyllosticta trillicola*, *Stagonospora Hiratsukana*, *Septogloeum Evonymi*, *Ramularia iwateyamensis*, *R. violae-brevistipulata*, *Cercospora Tokoroii*.

**604. Ueber den Einfluss des Zinks auf das Wachstum der Reispflanze** (Japanisch). M. TOKUOKA und H. MOROOKA. (Jour. Soc. Trop. Agric. **10**, 1938, 24-37).

Die gleichartigen Experimente wie bei zwei folgenden Nrn. wurden betreffend das Zink ausgeführt. Danach beschleunigt eine geringe Menge des Zinks das Wachstum der Reispflanze und lässt die Körner-Ernte zunehmen, während eine zunehmende Menge desselben schädlich wirkt. Bei der Wasserkultur wirkt schon 0,5 p.p.m. schädlich (Kulturwasser je drei Tage ausgewechselt), doch bei der Bodenkultur erst bei 1 p.p.m. Die Stickstoff-Menge in der Ernte nimmt mit der zunehmenden Menge des angegebenen Zinks zu, was beweisen soll, dass das Zink bei der Stickstoff-Assimilation günstig wirkt.

**605. Ueber den Einfluss des Kupfers auf das Wachstum der Reispflanze II.** (Japanisch). M. TOKUOKA und S. ZYO. (Jour. Soc. Trop. Agric. **10**, 1938, 9-23).

Mittelst der Wasserkulturmethode haben die Verff. den Einfluss des Kupfers auf die Vegetation der Reispflanze studiert. Danach obgleich eine sehr geringe Menge Kupfers (höchstens 0,005 p.p.m.) für das Wachstum, das Schossen, das Rispschieben und die Ernte günstiger wirkt als bei der Kontrolle, ist schon bei 0,05 p.p.m. Kupfers der schädigende Einfluss nachzuspülen, und bei 1 p.p.m. gehen alle Stöcke zu Grunde, ohne das Reifungsstadium zu erreichen.

Der Wechsel des pH-Verhältnisses während der Kultur hat gar keinen Einfluss auf das Wachstum. In diesen Experimenten wurde es festgestellt, dass die Wurzeln reicher an Stickstoff sind als die Halme, und weiter, je grösser die abgegebene Kupfermenge ist, desto reicher die Stickstoffmenge ist. Das gleichartige Verhalten besteht auch betreffend die in den Wurzeln und Halmen enthaltene Kupfermenge.



Aus alledem schliessen die Verff. dass die optimale Menge des Kupfers in der Kulturwasser 0,005–0,01 p.p.m. beträgt.

**606. Ueber den Einfluss des Bors auf das Wachstum der Reispflanze III.** (Japanisch mit deutsch. Zfg.). M. TOKUOKA und S. ZYO. (Jour. Soc. Trop. Agric. **10**, 1938, 151–157).

Die gleichartigen Untersuchungen wie bei dem vorigen Nr. wurden ausgeführt, um den Einfluss des Bors auf die Vegetation der Reispflanze kennen zu lernen. Die allgemeinen Resultate davon sind wie folgt:

Eine geringe Menge des Bors übt gar keinen Einfluss auf die Halmhöhe, Wurzellänge, Sprosszahl, Trockengewicht aus. Keine pH-Veränderung ist während der Kultur nachzuweisen, sodass es scheint, dass das Bor nicht unmittelbar auf die Reispflanze wirkt. Die Bormenge bis zu 10 p.p.m. lässt die Ernte der Körner zunehmen, und dieselbe bis zu 0,01–1 p.p.m. beschleunigt das Reispenschieben. Im allgemeinen kann man sagen, dass die Bormenge unter 10 p.p.m. der Reispflanze günstig wirkt; dieselbe über 10 p.p.m. ist schon schädlich, und 20% wirkt letal. Der Borgebrauch für die Wasserkultur lässt die Stickstoffmenge in den Halmen und Wurzeln abnehmen.

**607. On the blooming of *Nymphaea tetragona* GEORGI var. *angusta* CASP. subvar. *orientalis* CASP.** (Japanese). Akira TOKURA. (Jour. Japan. Bot. **14**, 1938, 344–354, 2 graphs).

The observations on the blooming of *Nymphaea tetragona* var. *angustata* subvar. *orientalis* were made by the author during three successive years 1934, 1935 and 1936. The results are summarized below:

The blooming of this aquatic plant takes place in Tōkyō most conspicuously in June and September, and less so in July and August. One and the same flower may open and shut during several days, 5–6 days in June and September, and 3–4 in July and August. Though concerning different flowers there is a considerable variation it may be said that in average the flower begins to open at 11 o'clock A.M., attains the full opening stage after 1–1 hour and still later, and shuts at 5–6 o'clock P.M. The greatest diameter of open flower measures 40–60 mm. Sunlight seems to have some positive influence on the flowering process, but the air or the water temperature seems to have nothing to do with it.

**608. *Spicilegium muscologiae Asiae Orientalis* 5.** (With Japan. résumé). Reizo TOYAMA. (Acta Phytotax. et Geobot. **7**, 1938, 102–111, 4 text-figs.).

Several species are enumerated, of which two new are described, viz. *Isopterygium propaguliferum* and *I. Tawadac*.

**609. Neue Triuridaceae micronesiens.** (Mit japan. Zfg.). Takasi TUYAMA. (Bot. Mag. Tōkyō **52**, 1938, 61–65, 113, 4 Textfig.).

Eine Triuridaceae, welche der Verf. zuerst im Humus des dichten Waldes am Flusse Aimiriik im Insel Babereudaobu der Gruppe Palaw Inseln entdeckte, nähert sich *Andrurus wariana* oder *khasiana*, doch ist deutlich daraus zu unterscheiden. Diese Art, welche vom Verf. für eine neue angenommen wird, wird *Andrurus palawensis* sp. nov. genannt und diagnostiziert.

**610. *Notulae ad plantas novae koreae*.** (With Japanese résumé). H. UYEKI and T. SAKATA. (Acta Phytotax. et Geobot. **7**, 1938, 14–19, 2 text-figs.).

The following new plants from Northern Korea are described among others: *Aconitum puchonroenicus* and *A. kaimaense*. Besides, a number of new varieties and forms are contained in the present paper.

**611. Experimentelle Untersuchungen lebender Zellen in der Teilung. I. Die Einwirkung des Chloroform- und Aetherdampfes auf die Mitose bei der *Tradescantia-Haarzellen*.** Bungo WADA. (Cytologia 9, 1938, 97-109, 2 Taf.).—**II. Die Einwirkung des Normalbutylalkoholdampfes auf die Mitose bei den *Tradescantia-Haarzellen*.** Von demselben Verf. (Ibid. 9, 1938, 110-119, 4 Textfig.).

Zu I.—Die Einwirkung des Chloroformdampfes auf die in der Teilung begriffenen Staubfadenhaarzellen von *Tradescantia reflexa* wurde untersucht, wonach der Effekt nach der Dosis des zugeführten Dampfes verschieden ist. Bei schwacher Zufuhr, nämlich, verändern sich weder die Spindelsubstanz noch der Phragmoplast, während die Chromosomen vorübergehend entquellen, und nach dem Entweichen des Dampfes werden die Kern- und Zellteilung normalerweise vollendet. Der durch starke Zufuhr des Chloroformdampfes verursachte Effekt ist irreversibel, insofern als der Dampf nekrotisch einwirkt und zur Koagulation und Absterben der Teilungsfigur führt.

Die Einwirkung des Aetherdampfes ist fast derselben des Chloroformdampfes gleich, doch ist der Effekt etwas schwächer.

Zu II.—Die Einwirkung des Normalbutylalkoholdampfes auf die Staubfadenhaarzellen von *Tradescantia reflexa* führt zur Verflüssigung und nachfolgenden Entmischung des Zytoplasmas, während die Spindelsubstanzen und die Phragmoplasten kaum, die Chromosomen nur wenig sich verändern. Alle solche Veränderungen sind reversibel. Dagegen ist der Effekt irreversibel, wenn die Einwirkung des Normalbutylalkoholdampfes stark ist. Sogar bei schwacher Zufuhr desselben erfolgt die Entmischung des Zytoplasmas, sodass zuweilen zufälligerweise gewisse Teilungsanomalien verursacht werden.

**612. The species of *Liagora* from Japan.** Yukio YAMADA. (Sc. Papers Inst. Algol. Res., Fac. Sc., Hokkaido Imp. Univ. 2, 1938, 1-34, 15 pls. and 22 text-figs.).

First of all, some short remarks are made on the anatomical details of the genus *Liagora*. The assimilatory filament in this genus is distinguished into two different types, the first being seen simply in the section Farinosae, and the second in all other forms. Two distinct types are also seen in spermatangia. In the one type they are produced around the ultimate cell of the assimilatory filament and form densely packed head-like clusters; this type is seen in those species with the assimilatory filaments belonging to the Farinosae-type (cf. above). In the second type the spermatangia are produced either on the ultimate or penultimate cell of the assimilatory filament in nearly corymbose manner. The carpogonial branches are also of two types. In the one they are evidently lateral on one cell of the assimilatory filament, while in the other they are lateral, subterminal or terminal. After fertilization the cystocarp is divided into two cells, usually by means of a horizontal cell-wall, but sometimes by a longitudinal one.

An analytical key to the Japanese species of *Liagora* is given. Each species is described and illustrated. The following species are contained in this paper: *Liagora orientalis* AGARDH, *L. caenomyce* DECAISNE, *L. robusta* sp. nov., *L. Boergesenii* sp. nov., *L. Setchellii* sp. nov., *L. japonica* sp. nov., *L. Segawai* sp. nov., *L. ceranoides* LAMOUROUX,  $\alpha$  *pulverulenta* (AGARDH) comb. nov.,  $\beta$  *leprosa* (AGARDH) comb. nov., *L. deussata* MONTAGE, *L. farinosa* LAMOUROUX, f. *pinnatiramosa* f. nov., *L. pinnata* HARV., *L. clavata* sp. nov., *L. mucocissima* sp. nov., *L. formosana* sp. nov.

**613. Notes on some Japanese algae VIII.** Yukio YAMADA. (Sc. Papers Inst. Algal. Res., Fac. Sc., Hokkaido Imp. Univ. **2**, 1938, 119-130, 13 pls. and 4 text-figs.).

The following algae are new and described with illustrations: *Coilodesme sagamiana*, *Erythroglossum pulchrum*, *Grateloupia carnosae*, *Scinaia pseudo-japonica*, *Sebdenia Okamurai*, *Sarcodia cuneifolia*.

**614. Observations on the *Arthrothamnus bifidus* J. AGARDH.** Yukio YAMADA. (Sc. Papers Inst. Algal. Res., Fac. Sc., Hokkaido Imp. Univ. **2**, 1938, 113-118, 5 text-figs.).

*Arthrothamnus bifidus* J. AGARDH formerly named *Fucus bifidus* by GMELIN is found abundantly near the Akkesi Algological Station of the Hokkaido Imperial University. In this paper the author's observations concerning the formation of sori as well as that of young blades from the auricles are described.

The sori of unilocular sporangia are produced at first on the under surface of the blades in two parallel rows which later will join together, though still later the sori are developed also on their upper surface. The full-grown auricles, 4-5 in maximum, roll inwards, and their innermost margin becomes thicker than the other part, forming the beginning of a new stem. This thickened part is cut off from the thin part, and begins to grow, mostly tearing off the upper marginal portion of the auricles as a sickle-shaped leaflet. On the new blades which are grown to about 30 cm two rows of bullations are already visible. While two young blades are growing, the old soriferous ones begin to decay. However, before they decay wholly, a spacious region which appears at the base of old blades cuts them off suddenly at that place, so that the cut-end is always rather smooth.

**615. On some culture experiments with the swarmers of certain species belonging to the Ulvaceae.** Yukio YAMADA and Eiji SAITO. (Sc. Papers Inst. Algal. Res., Fac. Sc., Hokkaido Imp. Univ. **2**, 1938, 35-51, 1 pl. and 12 text-figs.).

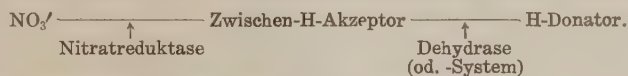
The culture experiments of gametes and zoospores of several Ulvaceae have given the results referred to below. *Ulva pertusa* is strictly dioecious, and the isogamy takes place. The gametes are 2-ciliate, and the 4-ciliate zoospores are produced on the asexual plants which are apparently quite similar to the sexual ones. The parthenogenesis is often observed. In *Enteromorpha Linza* the swarmers provided with two or four cilia are produced on different individuals, both of which will develop into the sporelings. In *Monostroma angicava* the male gametes are smaller than the female ones, and the zygotes will form after a certain time duration the zoosporangia which will represent small asexual generations. In another species of *Monostroma*, viz. *M. pulchrum* the authors could observe exclusively the 4-ciliate swarmers, which will germinate asexually. Swarmers in *Ulva pertusa* are provided with one eye-spot and react positively phototactic. The male and the female gametes of *Monostroma anglica* are also positively phototactic, whilst the zygotes are negatively so. Swarmers of *M. pulchrum* have no eye-spot and are insensitive to light.

**616. The marine algae from the Island of Yonakuni.** Yukio YAMADA and Takeshi TANAKA. (Sc. Papers Inst. Algal. Res., Fac. Sc., Hokkaido Imp. Univ. **2**, 1938, 53-86, 13 text-figs.).

The Island Yonakuni is placed at the western end of the Ryûkyû Archipelago, and is facing towards the northern part of Formosa. Its marine flora has heretofore never been investigated. In this paper all algae collected by one of the authors above indicated (TANAKA) are enumerated, incl. some new species. Among 102 species in all two new species are described: *Derbesia ryukyuensis* and *Spermothamnion yonakuniensis*.

**617. Über die Nitratreduktase von *Bacterium coli*. Untersuchungen über die biologische Reduction, I.** S. YAMAGATA. (Acta. Phytochim., **10**, 1938, 283-295, 1 Fig.).

An Hand von zellfreien Enzympräparaten wird die bakterielle Nitratreduktion ( $\text{NO}_3' \rightarrow \text{NO}_2'$ ) untersucht. Der Reaktionsmechanismus wird wie folgt dargestellt:

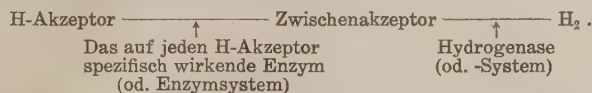


Die Nitratreduktase ist gegen Cyan sehr empfindlich.

NAKAMURA.

**618. Über die Hydrogenase, nebst einer Bemerkung über den Mechanismus der bakteriellen Knallgasreaktion.** S. YAMAGATA und H. NAKAMURA. (Acta Phytochim., **10**, 1938, 297-311, 5 Fig.).

*Bacterium coli formicum*, *Rhodobacillus palustris* und *Bacillus Delbrückii* haben je nach den Arten verschiedene H-Akzeptoren bei ihrer Hydrogenation. Das Reaktionsschema wird wie folgt dargestellt:



Die sogenannte Knallgasreaktion ist also eine  $\text{O}_2$ -Atmung, bei welcher das Wasserstoff-Hydrogenase-System an Stelle des üblichen Substrat-Dehydrasesystems auftritt.

Verff.

**619. Ueber die Ionenkonzentration des Antherenschleimes bei *Lilium*-Arten.** Gihei YAMAHA. (Proc. Imp. Acad. **14**, 1938, 81-82).

Bei *Lilium speciosum* und *tigrinum* wurde die Ionenkonzentration des Antherenschleimes, worin die Pollenmutterzellen eingebettet sind, elektrisch gemessen. Dabei wurden die pH- und die  $\Omega$ -Werte in verschiedenen Zuständen der Meiose der Pollenmutterzellen gemessen. Die Resultate der Verfs. Studien sind tabellarisch zusammengestellt. Danach sieht man, dass im Laufe der Meiose die H-Ionenkonzentration sowie die Gesamtkonzentration des Antherenschleimes ziemlich erheblich schwanken, d.h. pH-Wert 5,3-6,4 und  $\Omega$ -Wert  $1,4 \times 10^3$ - $2,5 \times 10^3$ . Das Minimum der Gesamtkonzentration (= das Maximum des  $\Omega$ -Wertes) tritt in Synizesis, Diakinesis sowie Anaphase.

**620. Potentialmessungen an den sich teilenden Pollenmutterzellen von *Lilium speciosum*.** Gihei YAMAHA. (Proc. Imp. Acad. **14**, 1938, 84-85).

Der vorliegende Aufsatz betrifft die Verfs. potentiometrische Bestimmung der freien Ladung des Protoplasmas der Pollenmutterzellen von *Lilium speciosum* in verschiedenen Teilungszuständen, deren Resultate tabellarisch zusammengestellt sind. Danach sieht man vor allem, dass gegenüber dem umgebenden Medium der Potentialwert der Zellfläche immer positiv, und der des Protoplasmas dagegen immer negativ ist. Weiter kann man in den oben angedeuteten Tabellen sehen, dass bezüglich dem absoluten Potentialwerte die Potentialdifferenz gegenüber der umgebenden Flüssigkeit auf der Zelloberfläche und im Zellinnern gleichmässig schwankt. Die grösste Potentialdifferenz weist man in früherer Prophase und Telophase, und die kleinste in späterer Prophase und Anaphase nach, so z.B. im Mittel 15,8 (millivolt) und 15,75 in früherer Prophase bzw. Telophase I, 4,5 und 4,75 in einem späteren Prophastadium bzw. Anaphase I.



**621. Observationes ad floram formosanam XIX-XX.** (With Japanese résumé). Yoshimatsu YAMAMOTO. (Jour. Soc. Trop. Agric. **10**, 1938, 111-129, 9 text-figs.; 176-186, 2 text-figs.).

Continuation of the author's studies of Formosan plants in the European and American herbaria. The species belonging to *Kyllingia*, *Juncellus*, *Mauscus*, *Heleocharis*, *Amorphophallus*, *Aneilema*, *Smilax*, *Philydrum*, *Juncus*, *Aletris*, *Dracaena*, *Allium*, *Lilium*, *Tricyrtis*, *Trillium*, *Paris*, *Veratrum*, *Smilacina* (with *S. nokomonticola* sp. nov.), and *Discorea*, *Taxus* are contained. The author's "Observationes" is completed with the appearance of No. XX which is reviewed above.

**622. Report concerning the study of weeds growing in the sugar-cane field in Formosa. (Preliminary note).** (Japanese). Yoshimatsu YAMAMOTO and Sigeyosi SUZUKI. (Rpt. from Soc. Sugar-cane Cultivation Study in Formosa **16**, 1938, 7 pp.).

The collection and study of weeds (incl. some trees and shrubs) growing in fields of sugar-cane in Formosa have been executed during 1933-1935. This paper is a preliminary account of the results of this investigation concerning the angiospermous plants. The general conclusion is briefly as follows:

The number of families—Typhaceae to Compositae—is 101 in all, which corresponds to 11% of that in whole Formosa, whilst the number of species goes up to 650 = 20% of the latter. Among these species 80%, 15% and 5% are represented by herbs, shrubs and trees respectively. Among all families the Gramineae are most numerous; the Leguminosae, Cyperaceae, Euphorbiaceae, and Polygonaceae follow them in descending order concerning the number of species contained therein. It is to be remarked that the number of species included in these 6 families goes up to 50% of the whole species number. Attention should be called to the fact that the degree of prosperity of weeds in fields is not measurable on the basis of the number of species contained in each family, but rather on that of the number of individuals of each species growing there.

At the end of the paper a list indicating all families, the number of species contained in each of them, as well as the life-forms (herb, shrub, or tree) is appended.

**623. Karyogenetische Untersuchungen bei der Gattung *Rumex*.** Yukio YAMAMOTO. (Mem. Coll. Agric., Kyoto Imp. Univ. No. **43**, 1938, 1-59, 4 Taf. und 21 Textfig.).

Die in der vorliegenden Abhandlung enthaltenen Angaben betreffend die Karyogenetik von *Rumex acetosa*, welche sich z.T. mit denen anderer Forscher, z.B. KIHARA, ONO usw. decken, werden unten kurz referiert werden.

Die somatischen Zellen dieser Pflanze, sowohl bei den Weibchen als Männchen, enthalten ausser den ihnen charakteristischen Geschlechtschromosomen 2X bzw. X + 2Y in normalen Fällen 6 Paare Autosomen (unten jedes derselben als a bezeichnet). Ihre Gestalt ist verschieden, d.h. i-, v-, J- oder T (Trabant tragend)-förmig. Auf Grund der Kombinationsweise der in jedem Kerne vertretenen Autosomensorten unterscheidet der Verf. 8 Karyotypen, z.B. ii-Typus (alle 6 Chromosomenpaare i-förmig), iivvJJ-Typus (i-, v- und J-förmige Autosomen vertreten) usw. Auch nach der Grösse der Chromosomen werden 6 Klassen a<sub>1</sub>, a<sub>2</sub>, a<sub>3</sub>, a<sub>4</sub>, a<sub>5</sub> und a<sub>6</sub> unterschieden, von denen die Chromosomen irgend einer und derselben Klasse gleichgross und dieselben verschiedener Klassen ungleich gross sind.

Die vom Verf. erwähnten merkwürdigen Tatsachen sind, 1. dass trotzdem gewisse Individuen von *Rumex acetosa* oftmals verschiedene Karyotypen oder verschiedene Chromosomenzahlen aufweisen, sie morphologisch voneinander gar nicht unterscheidbar sind, und 2. dass gewisse Individuen derselben Art bald eine hohe Sterilität, bald



dagegen eine ziemlich hohe Fertilität zeigen. Diese zwei Fragen hat der Verf. hypothetisch wie folgt aufzuklären versucht, und zwar auf Grund der neuerdings besonders bei einigen *Drosophila*-Arten nachgewiesenen Tatsache des Vorhandenseins der "inerten" und "aktiven" Region im Chromosom. Nach der Verfs. Ansicht, obgleich z.B. die Chromosomen-Translokationen usw. zum Kernpolymorphismus führen werden, werden dadurch keine morphologische Veränderung der betreffenden Individuen stattfinden, wenn sie bloss den inerten (d.h. leeren oder genlosen) Teil der Chromosomen antreffen werden, und weiterhin, die Fruchtbarkeit wird gar nicht beeinträchtigt werden, wenn nicht die Translokationen im aktiven Teil (gentragenden) der Chromosomen erfolgen werden.

Was die Geschlechtsbestimmung anbetrifft, muss man zwischen den Individuen, welche zu den Euploid- und Aneuploidreihe gehören unterscheiden. Bei der ersteren Reihe haben wir 2A- (A = ein Haploidsatz von a-Autosomen, welcher aus 6 Paaren der letzteren zusammengesetzt ist), 3A-, 4A-Männchen, Weibchen und Intersex, 5A-Weibchen und 6A-Intersex vor uns. Dabei lässt sich die Geschlechtsbestimmung der Regel nach nach der wohlbekannten BRIDGES' Theorie von "genic balance" bei *Drosophila* leicht erklären. So z. B.

$$\begin{array}{l}
 2A \left\{ \begin{array}{l} \text{♀ } 14 = 2X + 12a \\ \text{♂ } 15 = X + 2Y + 12a \end{array} \right. \quad 3A \left\{ \begin{array}{l} \text{♀ } 21 = 3X + 18a \\ \text{♂ } 21 = X + 2Y + 18a \\ \text{♀ } 20 = 2X + 18a \\ \text{♀ } 22 = 2X + 2Y + 18a \end{array} \right.
 \end{array}$$

usw.

Bei den Individuen der Aneuploidreihe stellt 2A + 1a immer das Weibchen dar, ob a zu irgend welcher von 6 Klassen ( $a_1$ - $a_6$ , vgl. oben) gehören mag. Wenn aber zwei oder mehrere a-Autosomen zu den normalen ♀ und ♂ hinzukommen werden, z.B. 2A + 2a, 2A + 3a, 2A + 4a usw., so wird das Männchen, Weibchen oder Intersex entstehen nach dem Klassenunterschiede der vertretenen a-Autosomen. So z.B.  $(2X + 2A) + a_1 + a_1$  (oder  $a_6$ ) = Intersex,  $(2X + 2A) + a_2 + a_5$  = Weibchen,  $(X + 2Y + 2A) + a_1 + a_1$  (oder  $a_6$ ) = Männchen,  $(X + 2Y + 2A) + a_2 + a_1$  = Intersex. Die im obigen genannte Geschlechtsbestimmung rührt nach dem Verf. davon her, dass den Autosomen  $a_1$ ,  $a_1$  und  $a_5$  die "Netto-Männlichkeitstendenz" und den  $a_2$  und  $a_5$  die "Netto-Weiblichkeitstendenz" innewohnen werden.

Für die in diesem Aufsatz enthaltenen weiteren Angaben sei auf das Original verwiesen.

**624. Untersuchungen über die phototropische Bewegung der Laubblätter von *Fatsia japonica*.** (Mit japan. Zfg.). Gingoro YAMANE. (Bot. Mag. Tōkyō, 52, 1938, 24-32, 3 Textfig.).

Wenn eine Längshälfte der in horizontaler Lage befindlichen Blattspreite eines Laubblattes beschattet und die andere von oben her senkrecht beleuchtet wird, wird bald seine seitliche Bewegung nach der Lichtseite erfolgen, was schon früher über *Sparmannia* und einige andere Pflanzen durch BALL und RAYDT festgestellt worden ist. Der Verf. hat die gleichartigen Experimente über *Fatsia japonica* ausgeführt, und auch die phototropische seitliche Bewegung der Blattspreite nach der Lichtseite nachgewiesen. Diese eigentümliche Bewegung beruht, wie die Verfs. Experimente klar gelehrt haben, eigentlich auf das Verhalten des Blattstieles, welcher an der Schatten- stärker als an der Lichtseite wächst und daher an der ersten konvex gekrümmt wird. Es ist daraus zu sehen, dass die Fortpflanzung des Lichtreizes aus der Spreite nach dem Stiel stattgefunden hat, insofern als bei diesen Experimenten die Blattspreite, nicht der Blattstiel, den Lichtreiz direkt empfängt. Der Unterschied

des Beleuchtungsgrades zwischen den beiden Längshälften der Blattspreite lag, soweit die Verf. Untersuchungen reichen, zwischen 2,4–15000 Lux, und dabei hat er immer die oben angedeutete positive und niemals die negative Reaktion beobachtet.

Die ökologische Bedeutung dieser Bewegung wird ohne weiteres klar sein, insofern als wo gelegentlich ein Blatt gerade oberhalb eines anderen kommt, um ihn zu beschatten, das letztere dank dieser phototropischen seitlicher Bewegung sich dem Schatten zu entziehen vermag.

**625. Ueber die Beziehung zwischen den Bewegungen der Laubblätter von *Fatsia japonica* und der Wuchsstoffwirkung.** (Mit japanischer Zfg.). GINGORO YAMANE. (Bot. Mag. Tōkyō 52, 1938, 82–92, 7 Textfig.).

Diese Abhandlung, welche eine Fortsetzung der im vorigen Nr. referierten ist, bezieht sich auf den Zusammenhang der oben beschriebenen phototropischen Bewegung des Laubblattes von *Fatsia japonica* und dem Wuchsstoff. Die Experimente des Verf., welche die Anschauungen von BALL und RAYDT bestätigt haben, wonach die in Rede stehende phototropische Bewegung auf die ungleiche Verteilung des Wuchsstoffes beruhen soll, sind wie folgt. Die mehr oder minder grosse Entfernung des Blattstiels aus der Spreite setzt das Streckungswachstum des ersteren stark herab, was auf die Verminderung des Wuchsstofftransportes aus der Spreite nach dem Stiel beruhen wird. Diese letztere Annahme wird durch die Resultate der Experimente gestützt, wobei der Zusatz von Heteroauxin ( $\beta$ -Indolylessigsäure)-Paste zu den dekapitierten Blattstielen ihre lebhafte Streckungswachstum verursacht hat. Das tatsächliche Vorhandensein des Wuchsstoffes in den jungen wachsenden Blättern wurde mittels der THIMANNs Extraktionsmethode klar nachgewiesen, ja sogar es gelang dem Verf., den Wuchsstoff von dem Blattstiele durch seine Schnittfläche in die Agarplatte hineinströmen zu lassen.

Die oben angedeuteten Resultate, zusammen mit den der hier nicht referierten überzeugenden Experimenten, haben den Verf. zu den Anschauungen geführt, welche mit denen von BALL und RAYDT übereinstimmen, im Gegensatz zu denen von LAIBACH, wonach man einen hypothetischen Stoff, welcher das Reaktionsvermögen des Gewebes gegenüber dem Wuchsstoff erhöhen soll, anzunehmen braucht.

**626. Myelin forms in acetocarmine snear preparation. Lecithin as a nuclear constituent.** KONO YASUI. (Cytologia 9, 1938, 120–131, 21 text-figs.).

In acetocarmine snear preparations of PMCs and tapetal cells in *Papaver*, *Hosta*, *Tradescantia* and *Magnolia* lipid drops come out from the tapetal and PMC nuclei and chromosomes. The drops stained with acetocarmine showed often various myelin forms in water or in acid medium, and sometimes in the nuclear and cell cavity. The stained oil drops are at first spherical, but after some days become the myelin forms first observed by VIRCHOW and so named by him: they are sometimes extremely thin, but sometimes thick and short. They are variously shaped, thus, for instance, coiled spirally, beaded, producing protrusions from their surface, appearing like a hollow bladder, etc. Several characteristics, for instance, the swelling by the absorption of water, the myelin form in acid medium, the stainability in acetocarmine, neutral red, methyl green, the reduction of osmic acid, the solubility in various media are quite similar to those of the lecithin from the hen's egg prepared by SCHERING-KAHLBAUM. This led the present writer to the view that the stained drops under question will represent the lecithin. The above observations seem, according to the writer, to offer a direct proof of the presence of a phosphatide, presumably lecithin, in the nuclei.

**627. Cyanophyceae of Japan II.** (With Japanese résumé). Yûichi YONEDA. (Acta Phytotax. et Geobot. **7**, 1938, 88-101, 4 text-figs.).

The following Cyanophyceae are enumerated. Chroococcaceae: *Aphanocapsa* (1 sp.), *Gloecapsa* (1), *Chroococcus* (1), *Coelosphaerum* (1), *Merismopedia* (1), *Synechococcus* (1 var.). Chaemosiphonaceae: *Chamaesiphon* (1). Stigonemataceae: *Fischerella* (1). Rivulariaceae: *Calothrix* (1), *Gloeotrichia* (1). Nostocaceae: *Cylindrospermum* (1), *Nostoc* (4). Oscillatoriaceae: *Oscillatoria* (1), *Phormidium* (1), *Lyngbya* (1), *Microcoleus* (1).

**628. Cytological studies of spermatoteleosis and fertilization in Pteridophyta, with special reference to the border-brim.** Akira YUASA. (Studies from the Tokugawa Inst. Biol. Res. **4**, 1938, 1-116, 3 pls. and 222 text-figs.).

This paper is a collected review of the author's numerous publications concerning the cytological researches on the spermatogenesis in a number of pteridophytes, with special reference to border-brim. (Cf. this JOURNAL **6**, (62), (122), **7**, (30), **8**, (34), (93), (95), (115), (116), **9**, (32), (97), (142), (143), etc.). The author's general conclusions in the present paper concerning the cytology of the border-brim run as follows. It originates from that part of the nucleoplasm other than the chromatin substance of the spermatid-nucleus, and at first it appears in the spermatid-cytoplasm as a spherical blepharoplast which later differentiates into the border-brim, lateral bar and cilia-bearing band. In fertilization the two former structures (sometimes together with the last) as well as the spermatozoid-nucleus enter the egg-nucleus.

**629. Critical considerations on the origin of blepharoplast. The nucleolar substance theory.** (With Japanese résumé). Akira YUASA. (Bot. Mag. Tôkyô **52**, 1938, 7, 318-328).

The development of the blepharoplast in the nucleus of antheridial cells has hitherto been observed in various Eufilicineae by various authors. As to the question, from what part of the nucleus the blepharoplast will be derived, the author comes to the conclusion that the nucleolus will correspond to it. The reason why such a conclusion has been attained is stated as follows: firstly, the blepharoplast and the nucleolus stain in a similar manner; secondly, both coincide in various physical and chemical characteristics; thirdly, in the planocyte of some Myxomycetes the origin of the blepharoplast from the nucleolus has been directly traced; fourthly, in both ferns and mosses no nucleolus is observed in the spermatid, but the two nucleoli are seen in the egg-cytoplasm; fifthly, the characters of the border-brim and nucleolus are similar, thus, for instance, both stain equally pale by acetocarmine, HEIDENHEIN's iron-haematoxylin and several other reagents; fifthly, no relation was observed between the blepharoplast on one hand and the cytosome or nucleoplasm on the other.

The centrosome is not visible in the pteridophytes generally, but basing on the observations of some cases, where it is visible during certain nuclear divisions, the author thinks that the blepharoplast and the centrosome belong to one and the same double structure.

**630. Notes on the effects of alcohol and acetic acid on spermatogenesis in *Isoetes japonica* AL. BR.** Akira YUASA. (Japan. Jour. Bot. **9**, 1938, 297-301).









